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THE WOLF PACK CONNECTION: A COMPARISON OF
WORLD WAR II WOLF PACKS AND MODERN
ATTACK HELICOPTER TACTICS

A thesis presented to the Faculty of the U.S. Army
Command and General Staff College in partial
fulfillment of the requirements for the
degree

MASTER OF MILITARY ART AND SCIENCE

by

STEPHEN A. INGALLS, MAJ, USA
B.S., United States Military Academy, West Point, New York, 1982
M.S., Georgia Institute of Technology, Atlanta, Georgia, 1992

Fort Leavenworth, Kansas
1996

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MASTER OF MILITARY ART AND SCIENCE

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ABSTRACT

THE WOLF PACK CONNECTION: A COMPARISON OF WORLD WAR II WOLF PACKS AND MODERN ATTACK HELICOPTER TACTICS by MAJ Stephen A. Ingalls, USA,
144 pages

This study explores a comparison of World War II submarine wolf packs and modern attack helicopter battalions. Descriptions of submarines using continuous employment, an attack helicopter technique, against mercantile convoys in the Pacific in 1945, and U-boat commanders describing their submarines as "hovering," offer at least a superficial relationship. This paper investigates the comparison in more depth using four battlefield mechanics: force, target, action, and counteraction.

A submarine engagement sequence is developed that offers striking similarity to the way helicopters maneuver against massed mechanized targets. While both forces must close with a massed target before employing their missile systems, helicopter forces, more than their World War II submarine "counterparts," emphasize long range engagements, benefiting from weapon standoff. The history, however, suggests American experience in the Pacific began to demonstrate benefits of more distant submarine engagements. Helicopter forces employ fire and maneuver, more difficult for submarines, which have only marginal speed advantage over their intended targets. While both forces attack, the scope of a wolf pack's attack is narrowed to achieve a single purpose: destruction of the convoy (vice neutralization or defeat allowed under the Army's doctrinal definition of attack). This differentiates the acceptable conditions under which helicopter and submarine forces break contact with their targets.

ACKNOWLEDGEMENTS

I always enjoy reading the "acknowledgements" section as it allows insight to the resources authors use as motivation, and offers some personal perspective, not normally presented in the written work. More than any initials I can hang after my name, and borrowing from a World War II commander in the 8th Infantry Division, a unit I was privileged to serve in, "these are my credentials."

My family has suffered the most throughout this study's preparation and has offered support only families can offer. My wife and children provided necessary distraction, offered the "oh cools" when appropriate, and chided my progress; always more threatening than the warnings and admonishments from my committee. More than anything, they offer my excuse for excellence I hope you find somewhere here.

My brother and sister have provided me unique opportunities to "think outside the box," and I appreciate their encouragement and pride in all that I have accomplished. They, and their spouses, are some of the most well-adjusted, successful adults I know. Collectively, we attribute our success to Mom and Dad: Mom encouraged us to ask "why" and Dad showed us how perseverance and hard work enables our answering those questions.

Dr. Rick Swain, Major Kevin Polczynski, Lieutenant Commander "Tad" Laurence, and Major Bruce Leeson offered critical guidance which allowed my question regarding this comparison to arrive at a logically-developed, cogent conclusion. I want to thank them for asking the questions I really did not want to entertain.

Commander J. J. Colgary and the crew of the USS Augusta opened the door to their submarine world, answered my questions, tolerated my invasion of their personal space, offered insight to my thesis' central question, and allowed me to sneak to the bridge with my Army football hat on Army-Navy game day for a picture. These pages do not adequately highlight their contribution to this thesis, but lessons from the week I spent with them are a professional highlight I hope to use for many more years.

Lastly, I want to thank soldiers and sailors who participated in the actions I describe here. Submariners, particularly German, suffered incredibly during World War II, yet served, as do all good soldiers, with pride and honor. My hopes are that their lessons learned, applied here in a unique way to my world of attack helicopters, advances my ability to lead men and women of America's armed forces. I salute their collective accomplishments and thank them for their sacrifice.

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LIST OF ACRONYMS

AA	Assembly Area
ARTEP	Army Training and Evaluation Program
ASDIC	Anti-Submarine Detection Internal Committee
ATKHB	Attack Helicopter Battalion
ATKHC	Attack Helicopter Company
AVUM	Aviation Unit Maintenance
BHL	Battle Handover Line
BP	Battle Position
C2	Command and Control
cm	centimeter
DVO	Direct View Optical
DTV	Daylight Television
EA	Engagement Area
EAC	Echelons Above Corps
EG	Escort Group
FAA	Forward Assembly Area
FARP	Forward Arming Refueling Point
FEBA	Forward Edge of the Battle Area
FLIR	Forward Looking Infrared
ft	feet
FLOT	Forward Line of Own Troops

LIST OF ACRONYMS (cont.)

FM	Frequency Modulated
fwd	forward
FY	fiscal year
HA	Holding Area
HF	High Frequency
HF/DF	High-Frequency Direction-Finding
HHC	Headquarters and Headquarters Company
hrs	hours
IAT	Image Auto-Tracker
km	kilometer
kph	kilometers per hour
kts	knots (nautical miles/hour)
lbs	pounds
LF	Low-Frequency
LRF/D	Laser Range-Finder/Designator
LT	Laser Spot Tracker
m	meter
Mhz	Megahertz
Mk	Mark (American torpedo designation)
MKS	Mediteranean to United Kingdom convoy designation
NOE	Nap-of-the-Earth

LIST OF ACRONYMS (cont.)

PNVS	Pilot Night Vision Sensor
SAM	Surface-to-Air-Missile
SL	Sierre Leone (Freetown) to United Kingdom convoy designation
sm	statute miles
SSN	Subsurface Ship Nuclear
TAC CP	Tactical Command Post
TADS	Target Acquisition and Designation Sight
TBS	Talk-Between-Ships
TSU	Telescopic Sight Unit
TTP	Tactics, Techniques, and Procedures
U-37	typical U-boat designation for Unterseeboot (U-boat) 37
UHF	Ultra High Frequency
USS	United States Ship
VHF	Very High Frequency
VLF	Very Low Frequency
WWII	World War II

CHAPTER 1
INTRODUCTION

Background

January 8, 0800 hours: Reconnaissance elements gain contact with a massed enemy formation and notify supporting attack units. The target, moving in a southerly direction, has good terrain masking to the west (their right flank). More successful engagement would therefore require canalizing the target along an avenue of approach away from this terrain and into an engagement area more suitable for use by several attack units simultaneously.

By 1500 hours, plans were finalized for an initial attack to turn the formation southeast into the more suitable kill zone. Attack assets are in position by 1618 hours, and at 1724 hours, the target is attacked from her right flank (figure 1).

Between 1914 and 1934 hours, supporting elements conducted a second attack against the now reduced formation (figure 2). A third attacking element hit the formation at 1956 hours (figure 3), with rotating engagements between the three attackers continuing until after 2200 hours against the now disorganized formation.

During this nearly five hour "run and gun" battle, over 50 percent of the enemy formation is either destroyed or rendered combat ineffective with no friendly losses.¹

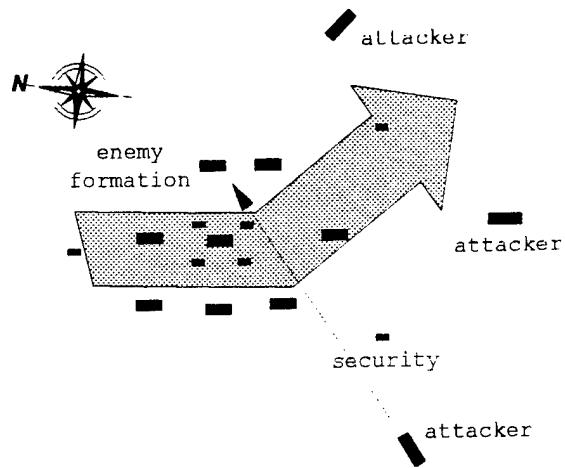


Fig. 1. Engagement schematic showing relative position of the enemy formation and associated security elements to attacking units at 1724 hours on 8 January.² The diagram is not to scale and security elements are representative of the type employed at this time.

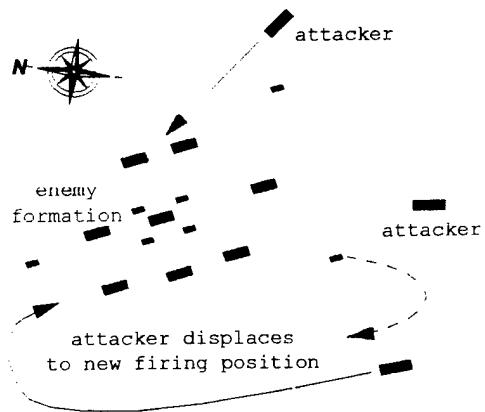


Fig. 2. Engagement schematic showing first attacker displacing to new firing position with security elements from the formation attempting to locate and counterattack (dotted arrow) (1914-1934 hours).³ Formation orientation is generally south-southeast (heading 140 degrees).

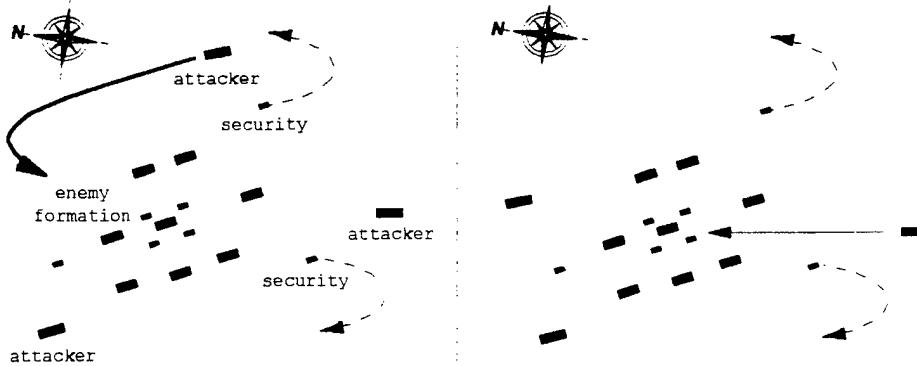


Fig. 3. Engagement schematic reflecting second attacker's displacement to new firing positions behind the formation and engagement by the third attacking element (1956 hours).⁴ Forward security assets have moved from their positions relative to the formation attempting to locate and attack the first two attacking units.

Readers may likely suspect the engagement described above is that of an attack helicopter unit, most likely a battalion, against a massed armored target. The method of rotational engagement by attacking elements, usually attack helicopter companies of the battalion, accurately reflects the continuous employment tactic (figure 4) described in U.S. Army Field Manual (FM) 1-112, Tactics, Techniques, and Procedures for the Attack Helicopter Battalion. Interestingly enough, however, this is not the case.

The engagement outlined represents actions by the USS Barb, USS Picuda, and USS Queenfish, U.S. Navy submarines operating as a wolf pack, against Japanese merchant convoy Mo-Ta 30 in the Formosa Strait on 8 January 1945 (figure 5). Of the eight merchant ships which left their Fuchou (north of Taiwan on the East China Sea) anchorage that morning, at least three were sunk during the engagement. Although

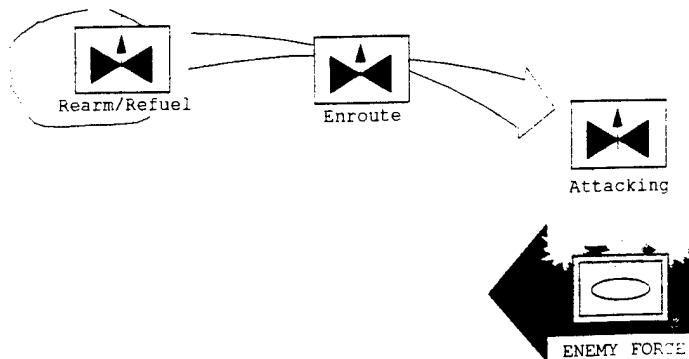


Fig. 4. Three attack helicopter companies of an attack helicopter battalion attacking using the continuous attack method. One of three companies is engaging the target while a second is enroute. A third is rearming and refueling. From FM 1-112, Tactics, Techniques, and Procedures for the Attack Helicopter Battalion (Washington: Department of the Army, 1991), 3-13.

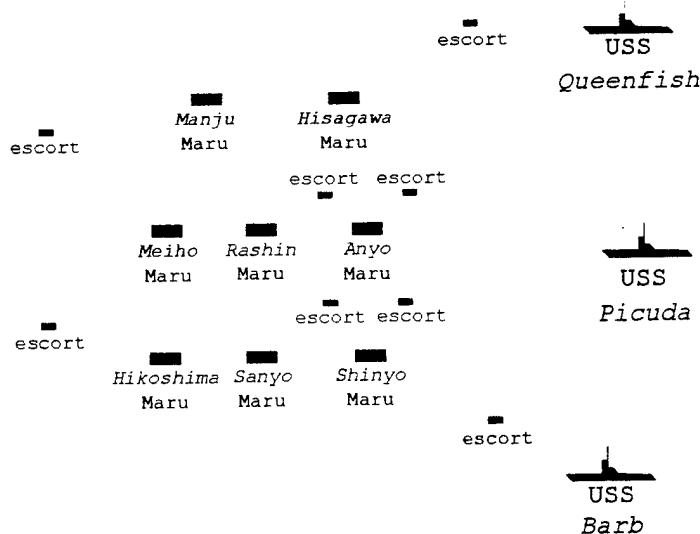


Fig. 5. Force disposition of Mo-Ta 30 and three submarine wolf pack on 8 January 1945. The convoy's composition was taken from Admiral Gene Fluckey's book, Thunder Below and presents vessels assigned to columns within Mo-Ta 30, but does not clearly delineate location within the columns.⁵ Escort positioning is not identified, but represents doctrinal placement.⁶

historical accounts disagree, another three ships were disputably hit and either ultimately sunk or ran aground.⁷

The Research Question

Is there a parallel in the tactical employment of World War II wolf packs and modern attack helicopters?

The parallel is, at least superficially, an interesting one in that both platforms use standoff weapons to attack their targets, operate in a third dimension, and, at least with wolf pack tactics, use multiple units massed against their target to increase attack lethality. Successfully drawing the comparison between these two forces highlights appropriate doctrine and tactics for both services, and illustrates how techniques employed by "comparable" forces in the Army may prove useful to their "sister" force in the Navy, and vice versa. These introductory comments will outline key definitions, identify supporting issues, establish scope of the effort, and highlight anticipated outcomes.

Key Terms

Attack Helicopter: Unlike their predecessors in the Vietnam conflict, which were utility helicopter platforms modified to carry armament, attack helicopters are rotary-wing platforms designed exclusively to deliver munitions. In the United States, attack aircraft designations are preceded with an 'A' (i.e. AH-1, AH-64).

Attack Helicopter Battalion: An attack helicopter battalion is an aviation maneuver element organized with three subordinate attack helicopter companies, a headquarters company, and an aviation unit maintenance company (AVUM).

Engagement Area: FM 101-5-1 defines an engagement area as "an area in which the commander intends to trap and destroy an enemy force with the massed fires of all available weapons."⁸

Modern: The research question speaks to comparison with modern attack helicopters. For the purposes of this study, modern constitutes the attack helicopter experience from Desert Storm through the present.

Tactics: *Tactics*, like those of the wolf pack or continuous engagement by attack helicopters, are defined as "the art and science of employing available means to win battles and engagements."⁹ The art involved speaks to the human dimension in employing combat force, an important factor in evolving submarine tactics during World War II.

Tactical Level of War: This study will focus on actions by these two forces at the tactical level of war. As defined in U.S. Army Field Manual 100-5, this "level of war is concerned with the execution of battles and engagements."¹⁰ "At the tactical level of war, battles and engagements are planned and executed to accomplish military objectives assigned to tactical units or task forces. These victories, put together, achieve operational results."¹¹

U-Boot (U-Boat): U-boat is the shortened form of the German Unterseeboot, meaning "under sea boat", and is equivalent to submarine in that language.

U-Bootswaffe: U-bootswaffe stands for "under sea boat force" in the German language and represents submarine forces subordinate to the German Naval High Command during World War II.

Wolf Pack: A *wolf pack* consists of multiple submarines directed to operate in concert against a target or series of targets.

The following discussion introduces an analytical framework that supplements these definitions with the concepts of force, target, action, and counteraction.

Secondary Research Questions

What Method Can Be Used to Establish the Submarine-Helicopter Comparison?

Battlefield Mechanics

A common framework for analyzing separate engagements is required to establish a parallel in the way attack helicopters and submarines fight. This comparison is less concerned with the engagement's "why" than with the tactics, techniques, and procedures (TTP) used, the "how". These TTPs, where they exist, unfortunately focus specifically on the submarine or helicopter force and do not provide an overarching analysis tool. This study proposes a set of battlefield mechanics: force, target, action, and counteraction, which provides broad comparative categories for these two types of engagements. The battlefield mechanics are fully developed here to provide a framework for presenting details of the submarine and attack helicopter forces considered.

The American Heritage Dictionary defines mechanics as, "the analysis of the action of forces on matter or materiel systems."¹² Three of the four battlefield mechanics proposed for this study are determined by highlighting the nouns of this definition. Mr. Ralph V. Buck suggested the fourth mechanic, counteraction, in his phase one report to the Director of Strategic Sealift, "Merchant Ship Attrition:

A Historical Perspective." Mr. Buck characterized the struggle between Britain and Germany over strategic sea-lanes (known as the Battle of the Atlantic) "in an almost classical sense of move and countermove."¹³ A definition and discussion of these four battlefield mechanics is required before moving to their application.

Action

Action is maneuver of the attacker against the attacked to include target location and spatial orientation of the two in space and time. It describes the manner in which either submarine or helicopter forces approach their respective target arrays and position themselves around an engagement area against that target. Examples include the selection of various helicopter terrain-flight techniques or air axes toward an engagement area. With either force, characteristics of firing positions and ranges to the target are considered. This mechanic will therefore help explore the similarity and differences in the attacker's tactics, techniques, and procedures.

Force

Force outlines the doctrinal purpose, delivery platform, and weaponry for both the attacker and counterattacker, inclusive of organizations formed for the attack or counterattack. For purposes of analysis using this framework, forces involved in either a submarine or helicopter engagement will specifically exclude the target, except in cases where the target may also serve as its own counterforce. To illustrate, submarine and torpedo characteristics, including doctrinal aspects of the World War II submarine arm and organizations formed to

accomplish those missions (i.e., wolf packs), are representative considerations of the force. An evaluation of World War II convoy escort group capabilities (the counterattack) would complete force considerations for a given engagement, or for a series of connected engagements. This battlefield mechanic does not address the target, in this case the merchant marine vessels protected by the escort force, except as circumstances arise where the vessels themselves were armed to perform an antisubmarine role.

Discussions of the *force* mechanic will also highlight the human impact on engagements. In an interview with John F. Wukovitz for the Military History magazine, World War II submarine Fireman 3rd Class Thomas R. Parks explained that "the crew, and everything else on the submarine, formed the weapon, and our captain was the man with his finger on the trigger."¹⁴ This comment highlights the important relationship between delivery platform (the submarine), weapon system (the torpedo), and the crew.

Target

Target is the object of the force application. The following two passages define targets considered in this study:

The primary mission of an attack helicopter battalion is "to destroy massed enemy mechanized forces and other forces with aerial firepower, mobility, and shock effect."¹⁵

During the naval conflict in the Pacific between the United States and Japan, 1941-1945, there was a little-known war-within-a-war: the U.S. submarine offensive against Japanese merchant shipping and naval forces.¹⁶

In a manner similar to this study's comparison between attack helicopters and submarines, this effort must also compare and contrast

the nature of massed mechanized forces with merchant marine convoys.

The brief quotation presented above speaks to submarine warfare against Japanese merchant shipping in the Pacific. In addition, the evolution of wolf pack tactics necessarily involves a study of the Battle of the Atlantic, where Allied merchant shipping was again the objective and unique characteristics of convoy operations in the Pacific and Atlantic theaters are important to contrast in the analysis.

Counteraction

Counteraction includes the activity of both the target and counterattacker to limit the attacker's force application and includes a discussion of active and passive defensive measures taken to modify the attacker's action. The "activity" referred to above encompasses both maneuver and fires.

Alternative Dynamics

Developing this framework presupposes existing doctrine and military thought are insufficient on the subject of battlefield mechanics. Although not an exhaustive search, FM 100-5, Richard Simpkin's Race to the Swift, and Matthew Allen's Military Helicopter Doctrines of the Major Powers (1945-1992): Making Decisions About Air-Land Warfare were reviewed for their thoughts on battlefield dynamics.

As the Army's benchmark doctrinal manual, FM 100-5 presents four dynamics of combat power: *maneuver, firepower, protection, and leadership*. A first glance would suggest that this list is useful to the task at hand, with the previously defined set of battlefield mechanics incorporating aspects of these doctrinal dynamics. Applying

the dynamics of combat power to a helicopter engagement, as an example, reveals the difficulty in standing back from the action to assess the interrelationship of attacker, target, and counterattacker. FM 100-5's dynamics would help characterize each of these individually but do not allow a more "macro" analysis of the engagement.

In Race to the Swift, Simpkin addresses battlefield dynamics against the backdrop of "manoeuvre theory." He describes it as a three-dimensional system dealing with "the interaction of mass, time, and space."¹⁷ Further amplification develops the theory of mass into momentum (mass times velocity) with Simpkin eventually picturing manoeuvre theory as composed of two distinct masses (one enemy (E), one friendly (M)), the friendly mass at the end of a long lever hinged to a base he characterizes as the "holding force" (figure 6).¹⁸ One can

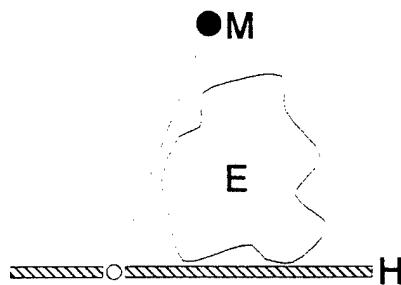


Fig. 6. Manoeuvre theory model presented by Richard E. Simpkin on page 21 in Race to the Swift. M reflects the mass of an attacking force, hinged to a base, or holding force (H), with an enemy mass (E) sandwiched between the two. Source: Richard E. Simpkin, Race to the Swift (London: Brassey's Defence Publishers, 1985), 21.

reasonably argue that submarines and helicopters are unable to provide the base holding force (H), which is the foundation of this theory, at

least as described by Simpkin. Further, as manoeuvre theory "regards fighting as only one way of applying military force,"¹⁹ application to submarines and helicopters, which rely on undetected approach and long-range fires, is inappropriate. In the submarine's case, history discusses how the threat of a wolf pack's appearance often required merchant marine convoys to change course. Success in the Battle of the Atlantic, however, was obtained by destroying vessels, not displacing them.

Matthew Allen's work on helicopter doctrine addresses the issue: "How shall they be employed?"²⁰ That question is directly related to the focus of this study, although Allen goes on to suggest one must not consider weapons (hardware) and ideas ("how to fight" doctrine) simultaneously. Each, although influenced by the other, has unique dynamics. In drawing the initial parallel between submarine hardware of World War II and modern helicopter weapon systems, this study focuses on two distinct points in history. While hardware development continued through the war, and evolves to a certain extent during modern times (from Cobra to Apache helicopter), that development, particularly in the Second World War, is crucial to this study and cannot be excluded.

Conclusion

In light of these existing doctrinal shortcomings, *action, force, target, and counteraction* are proposed as a structure within which submarine and helicopter engagements are analyzed. Appropriate aspects of the dynamics of combat power and manoeuvre theory will be

discussed under the four proposed mechanics. Exploration of the World War II submarine experience with "pack" tactics will precede discussion of attack helicopter employment techniques. Once presented, both are then analyzed using the battlefield mechanics just developed.

Having defined the framework for analysis of submarine and attack helicopter forces, other secondary issues, explored in subsequent chapters, are now presented.

What Differences Existed Between Wolf Packs
in the Pacific and Atlantic Theaters?

Admiral Karl Doenitz, commander of Third Reich submarine forces, began developing the idea of wolf pack tactics, or rudeltaktik, as a result of his submarine experiences during World War I. Advancing his ideas between the world wars, Doenitz first conducted large-scale fleet operations using the wolf pack in the autumn of 1937.²¹ It was not until late 1940, however, that pack tactics were applied, owing largely to insufficient numbers of fleet submarines during the early months of the war.²² With few technical or tactical countermeasures prepared, Allied shipping was devastated by the unforeseen submarine threat. Unfortunately for the U-bootwaffe, a combination of technical advances in radar, Allied interception of German radio traffic, increased convoy escort coverage, and a lack of appreciation by German strategists (and subsequent lack of resource priority) for what the submarine might accomplish, resulted in ultimate defeat for Doenitz in the Battle of the Atlantic.

In contrast, the Pacific Navy entered the war with no clear submarine strategy. Although the Navy had experimented with "section tactics" in the 1930s, the method was abandoned as posing too many restrictions on freedom of action.²³ In September 1943, however, the USS Shad, USS Grayback, and USS Cero attempted the first wolf pack attack by Pacific submarine forces.²⁴ Unlike the Allies, the Japanese were never able to effectively counter the pack tactic.²⁵ A thorough analysis of these differences is accomplished in chapter 4.

How Do the Major Powers Differ in their Application of Attack Helicopter Units to Massed Enemy Formations?

Matthew Allen's Military Helicopter Doctrines of the Major Powers, 1945-1992 highlights the growing pains of aviation elements in the United States, the former Soviet Union, Great Britain, France, and Germany. An interesting contrast to theater specific wolf pack tactics, Allen highlights these countries' struggle to simply define a role for their attack helicopter assets, with no universal agreement on their application against massed armored and mechanized targets. Where appropriate, chapter 5 will address unique aspects of these nations' attack helicopter forces and the tactics, techniques, and procedures that would define their actions with respect to those of another power.

How Does the Unique Environment of the Submarine or Helicopter Influence the Comparison?

While chapter 6 attempts to explore the submarine/helicopter parallel using the battlefield mechanics framework previously outlined, unique characteristics of the third dimensions in which either force

operates, the sea or air, require exploration. To a degree, each offers the attacker different means of hiding from targets and counterattacking assets, with those differences often the driving influence behind development of antisubmarine and antihelicopter devices and forces. This study will concentrate on unique characteristics of the counterforce in helping to identify the "cloaking" characteristics of each fluid medium.

Limitations to the Research Effort

Primary resources outlining U.S. Navy doctrine and tactics are limited. Many of the tactics ultimately applied through World War II were a result of individual ingenuity. In fact, although the Navy had formally experimented with "section tactics" and had tried simultaneous night surface attacks late in 1941²⁶, the first attempted wolf pack was preceded by "the three skippers and their execs [gameboarding] tactics with Momsen on the black and white tile dance floor of the sub base officers' club."²⁷ Many of these tactics therefore are derived from secondary histories. To the maximum extent possible, multiple secondary sources are consulted to either confirm accounts or to "piece together" events of a given engagement.

Another limitation deals with the first in that secondary sources on World War II discussing U.S. Navy or Kriegsmarine actions are numerous. To that end, generally recognized "authoritative" histories of the war are utilized.

Lastly, history of the attack helicopter is significantly less mature than the submarine. Only in the Gulf War were attack helicopters

employed with the backdrop of "modern" doctrine and tactics. History shows the success of wolf pack tactics and their evolution during World War II, while the continuous attack methods of modern attack helicopters are limited to a single data point derived during a 100 hour war.

Delimitation--Focusing the Effort

Theodore Roscoe describes thirteen different tactics employed by U.S. Navy submarines during World War II.²⁸ Of those, wolf pack is the only collective tactic, the other twelve describing methods used by individual boats against their targets. This research effort will concentrate on the wolf pack, but include single boat tactics as they were utilized within an engagement.

With an eye on the tactical level of war, this study concentrates on actions about a hypothetical engagement area. Although tempting, a logical air-to-air analogy, exploring either counter submarine or counter helicopter warfare is not addressed.

The research question, finally, considers a very specific comparison between submarines and helicopters. After having analyzed the parallel between World War II wolf pack tactics and modern attack helicopter employment techniques, the reader may rightfully ask: so what? An answer to this question lends itself to a discussion of the study's significance.

Significance of the Study

In the past fifty years, attack submarines have evolved into highly lethal, high stealth, autonomous weapons platforms. Submarines in World War II were arguably an immature force struggling for a defined

role in naval warfare. Some suggest American submarine successes against Japanese merchant shipping had crippled the country to a point where Allied invasion and dropping nuclear munitions were unnecessary.²⁹ Historians also suggest a similar fate was possible in Europe, had Great Britain been equally inept in dealing with the Axis submarine threat. These circumstances mark a dramatic change in attitude about the submarine from pre- to post-World War II.

The comparison of World War II wolf packs to modern attack helicopters not only attempts to draw the parallel in forces, but finds these two entities at similar points in their development: immature, incompletely defined military elements still struggling for a recognized role in armed conflict. Arguably, attack aviation, like the post-World War II submarine force, has finally established itself in the post-Desert Storm military.

As Army Aviation looks to the future with their restructuring initiatives and continued focus on advanced airframes like Comanche and Apache Longbow, insight to the twenty-first century fighting force and projected threats are important. The submarine force faces these same questions, but has had the benefit of a fifty-year maturation to deal with this change. Given the attack submarine/helicopter parallel exists, it is natural to wonder whether future helicopter forces will also evolve to the high stealth, high lethality, autonomously-employed weapons systems the attack submarine exemplifies.

In addition to Army Aviation drawing lessons from the submarine force, attacks against enemy naval forces and interdiction of sea lines of communication are still postulated as missions for the U.S. Navy,

with the submarine force expected to play a major role. The concept of massed fires and synchronized attacks therefore seemingly have contemporary application. Having developed the helicopter continuous attack over the past twenty-five years, perhaps naval tacticians can look to the Army for insight, should wolf pack operations again prove necessary.

CHAPTER 2
LITERATURE REVIEW

Introduction

The previous chapter outlined the principle issue under study, existence of a parallel in tactical employment of World War II submarine wolf packs and modern attack helicopters. The chapter also attempted to establish bounds for the study issue while highlighting additional questions requiring exploration in order to determine the degree to which employment of these two forces are similar. A set of battlefield mechanics (force, action, target, and counteraction) were proposed as a framework for comparison. The literature review must identify sources that discuss World War II submarine wolf packs and modern attack helicopter tactics, and references which permit their comparison in terms of the defined battlefield mechanics.

The fiftieth anniversaries of major events throughout World War II have renewed interest in that conflict. The results are a number of newer histories and personal memoirs concerning activities in the Atlantic and Pacific theaters by both Axis and Allied authors. Fifty years have allowed scholars the opportunity to determine which works serve as the definitive histories of that war. Time has had the opportunity to temper earlier observation, by both combatants and contemporary historians, with an understanding of the broader context in which actions took place. The end state is a collection of well-

documented histories, supplemented by personal memoirs, which add a human perspective to the sometimes sterile description of actions in combat.

In contrast, the study of the employment of attack helicopters has not benefited from historical perspective to the same degree as the use or fighting of the submarine force. Reorganization of the 11th Air Assault Division (Test) and 2nd Infantry Division into the 1st Cavalry Division (Airmobile) in 1965¹ arguably marks the organized introduction of Army aviation into modern combat. The difficulty with these early histories is that tactical employment of aviation has changed significantly since 1965, and the *modern* tactical employment is the focus of this research.

Attack helicopter tactics, like the continuous employment method (chapter 1), did not see combat until Desert Storm. A post war Government Accounting Office report highlighted that AH-64 units performed a range of missions (attack, reconnaissance, and security), with only thirty-four classified as attack (41 percent of all missions).² These are the missions where the tactics useful in comparison to wolf packs will present themselves, and in which conditions of the target, action, and counteraction are most appropriate for this study.

Authoritative histories and finalized after action reports on the Gulf War remain unwritten. Gulf War commanders' critical commentaries necessarily require time for reflection. Other military sources useful to this study remain classified. Apart from doctrinal publications which outline tactical procedures, it is, therefore,

difficult to determine which works on modern attack helicopter employment will emerge as the "critical sources." These arguments notwithstanding, lessons learned from attack helicopter units that participated in this combat are an important reference, combined with preliminary analysis of the war with Iraq, as well as references discussing evolution of the attack helicopter force prior to that conflict.

There are no published works that directly address the comparison of attack helicopters to submarines. However, as recently as the December 1995 issue of the Naval Institute's Proceedings, a letter to the editor suggests:

it might do well once again to draw a parallel between a naval force's submarines and an army's cavalry, whose classic role is to reconnoiter, to surveil, to disrupt an opponent's command-and-control structure, to surprise enemy forces from unexpected directions, and to attack logistic tails with a broad selection of carried weaponry.³

While likely referring to roles and missions, rather than comparing how the two forces fight, others have apparently crossed service lines to draw parallels between army assets and the submarine force.

Absent works addressing this comparison, the literature review will focus on the World War II submarine and modern attack helicopter forces individually, highlighting works which allow discussion of the two in terms of *force, action, target, and counteraction*.

The World War II Wolf Pack Experience

The wolf pack experience is an inextricable piece of the larger World War II submarine history, generally discussed in the context of

Admiral Karl Doenitz's *U-bootwaffe* and their unrestricted campaign against Allied merchant shipping. Lesser known, but perhaps having influenced the outcome of combat in its theater even more, was the U.S. Navy's use of similar tactics in the Pacific beginning in 1943.

The organization and protection of Japanese marus (merchants) in the Pacific, and the extravagant Allied merchant convoy system in the Atlantic, both influenced the manner in which wolf packs were fought and the degree to which they were ultimately successful. A review of wolf pack operations during the Second World War must, therefore, highlight the similarities and differences of their employment in these two theaters.

Wolf Pack Operations in the European Theater

Force and Action

As the "architect" of the German wolf pack, Admiral Karl Doenitz's Memoirs - Ten Years and Twenty Days, provides important insight into his rationale for having adopted wolf pack tactics, to include preparations made by the German Navy between the wars to ensure her submarine fleet was capable of carrying out such attacks. He also discusses employment principles for submarines attacking convoys or single ship targets and outlines his thoughts on an overarching submarine strategy for the war.

Perhaps the most important reference in understanding how wolf packs were fought was Doenitz's The Handbook for U-Boat Commanders. In Memoirs, he discusses his desire to keep the new tactic a secret, and purposely avoided their description in some of his other writings. The

Handbook incorporates the tactics' evolution from their first orders in 1935 through the fleet maneuvers of 1937 and represents, perhaps, the clearest insight into these "group tactics."⁴

More general historical references dealing with the Battle of the Atlantic, as the German submarine war with Britain was called, and Germany's U-boat campaigns through the First and Second World Wars are plentiful. "The strategic and tactical evolution of the U-boats through the two world wars, tracing how vessels originally conceived as coastal defence units evolved into a deadly menace and came close to being the single decisive factor in both wars,"⁵ was the aim of V. E. Tarrant in The U-Boat Offensive: 1914-1945. More specifically, Time-Life's [from the World War II series] The Battle of the Atlantic provides a mostly pictorial history while offering a first-hand perspective from author Barrie Pitt, who served with the Royal Navy in the Mediterranean and European theaters during the war.

While the previous examples will provide important insight to the *force* and *action* battlefield mechanics, it is also necessary to look at the hardware involved. Between 1935 and 1945, the most-produced German submarine was the Type VII.⁶ David Westwood's The Type VII U-Boat provides technical details for both this boat, which represented at least 61 percent of all Third Reich submarines, and the torpedoes it carried.

With regard to *force*, the chapter 1 definition was careful to include the human dimension. To that end, memoirs of Knight's Cross Winner Peter Cremer, U-Boat Commander, and of U-boat officer Otto Giese,

Shooting the War, provide personal insight to wolf pack employment and the growing threat to their submarines from Allied countermeasures.

Target

The Germans knew, of course, that seaborne commerce was vital to Britain's survival. The admirals of the German Navy had plans to use the battleship and cruisers to sink merchant ships on the high seas. They also planned to sow the waters around Britain with deadly mines, and to employ armed merchantmen disguised to look like innocent freighters to sneak up on unwary captains and blow their ships out of the water. But Doenitz and his staff had always known that their chief hope of blockading Britain lay in the U-boats, which could sink the ships that were bringing in supplies and troops across the Atlantic.⁷

Merchant Ship Attrition: A Historical Perspective, a technical report drafted for the Director, Strategic Sealift Division in 1986, "traces the history of sealift protection, with primary concentration on World War II."⁸ The report looks at the war in seven phases and offers statistics on merchant ship attrition, seeking to understand the combination of tactics, hardware, experience, and training which were most lethal to the Allies' strategic sealift efforts. John Winton presents a more comprehensive history in Convoy: The Defence of Sea Trade, 1890-1990. Winton traces arguments leading to adoption of the convoy system in World War I and continues to detail its application throughout World War II.

Counteraction

Stephen W. Roskill's The War at Sea is most often quoted by Doenitz in his attempt to capture British and Allied reaction to the U-boat threat. As the "big picture," Roskill's volume one of a three volume work, subtitled The Defensive, describes Britain's early

unsuccessful naval campaign through participation of the United States in escort operations and with armed merchant ships.

Geoffrey P. Jones' Defeat of the Wolf Pack discusses how new anti-submarine tactics and weapons systems brought to bear in the 1943-1944 time frame, coupled with British intelligence's code-breaking and message intercepts, ultimately led to victory in the Atlantic. Commander D.A. Rayner presents a more personal account in his work, Escort. This reference, edited by Captain Roskill, presents Rayner's experiences fighting U-boats while serving aboard numerous escort vessels in the Atlantic from 1939 to 1945.

U.S. Navy Wolf Packs in the Pacific

Force and Action

If there is an American Roskill writing on naval warfare in the Pacific during World War II, particularly on the subject of submarines, it is Clay Blair, Jr. His work Silent Victory traces submarine development from very early Holland boats in the late-1800s through victory over Japan. Dealing exclusively with the Navy's infant submarine force, Blair chronicles its early misuse after Pearl Harbor through employment of fledgling wolf pack operations in late 1943 to President Truman's decision to drop the atomic bomb.

Another authoritative work is Theodore Roscoe's United States Submarine Operations in World War II. The importance of this work is its description of thirteen different tactics fleet submarines employed throughout the war. With few doctrinal U.S. Navy publications, even today, Roscoe illustrates each tactic by highlighting the "inventor" and

combat action which best demonstrated the method. He provides an overview of coordinated submarine attacks through a listing of all U.S. Navy wolf packs organized throughout the war with Japan.

Two of the top four submarine commanders of World War II have written books describing their experiences in the Pacific. Admiral Eugene Fluckey's, Thunder Below!, outlines the five war patrols he made as commander of the USS Barb. Admiral Richard O'Kane's Clear the Bridge! is a second history of this type, and relives his experience as commander of the USS Tang. While both won the Medal of Honor, of more interest is the different way they directed their respective submarines to fight the war. Commander Fluckey more often employed the Barb as a wolf pack member, enjoying the success this tactic brought through the mutual support of other submarines. O'Kane fought to ensure the Tang was never assigned a pack and conducted five independent war patrols. While it is important to appreciate the differences in World War II submarine employment, both also highlight life aboard World War II boats, crew dynamics, and personalities of submarine commanders. In fact, the radical change in the personality of submarine commanders is a chapter in Stephen Peter Rosen's Winning the Next War: Innovation and the Modern Military. Among other more conventional "innovations," Rosen speaks to the change toward younger, more audacious submarine skippers as a critical innovation which ultimately contributed to the defeat of the Japanese merchant fleet.

As with the Type VII submarine, a discussion of wolf pack operations in the Pacific theater must include an overview of boats and torpedoes. Published by the Naval Institute Press, U.S. Submarines

through 1945 by Norman Friedman, offers an "illustrated design history"⁹ of boats and weapon systems covering the same time frame discussed in Blair's Silent Victory.

Target and Counteraction

Numerous sources point to the Japanese merchant marine fleet as the obvious target of submarine operations throughout World War II. Unfortunately, however, scant literature seems available that addresses characteristics of the Japanese merchant fleet, convoy system, or escort force to the degree discussed by references on war in the Atlantic. Perhaps, the lack of any such reference is testimony to Japan's difficulty in developing a successful convoy system or organized anti-submarine campaign. Regardless, the characterization of these battlefield mechanics must rest on Roscoe, Blair, O'Kane, and Fluckey.

Chronology of the War at Sea, 1939-1945

This last work by J. Rohwer and G. Hummelchen is a compilation of naval action throughout the war in both theaters. It provides an overview of dates, times, personalities, and forces involved in most major naval operations. It, along with a number of lesser sources, serves to confirm actions reported in the more substantive histories.

The Modern Attack Helicopter Force

Apart from a few books written about the helicopter experience in Vietnam, few references outside doctrinal publications exist that address modern attack helicopter battalions (ATKHB) and their employment.

Matthew Allen offers a broad, and seemingly objective, overview of aviation force development in Military Helicopter Doctrines of the Major Powers, 1945-1992. In this book, Allen examines evolving force structure and helicopter systems in the United States, the Soviet Union, Great Britain, France, and West Germany and concludes by postulating future contributions of aviation to air-land warfare.

Allen's work, however, does not address the details of modern attack helicopter forces in sufficient depth to make *force, action, target, and counteraction* comparisons to submarine wolf packs. The difficulty appears to reside in the "shallow" nature of attack aviation's history. Whereas submarines arguably were used successfully for the first time in World War I, providing that force almost eighty years of historical analysis and combat experience, helicopters have scarcely a thirty year "modern" existence with only Desert Storm serving as a mid- to high-intensity combat test. Analysis, therefore, must include a review of available lessons learned, after action reports, and unit histories from the 15 Apache-equipped units that fought in Desert Storm.

Force and Action

Apart from Allen's work mentioned above, the best source of information regarding attack helicopter force structure and tactics are the Army's doctrinal publications.

With consolidation of aviation branch proponency at Fort Rucker in the early 1980s, doctrine writers began publication of the aviation-specific "1-" series manuals with FM 1-100, Combat Aviation Operations,

the branch's first capstone manual. The manual was superseded in 1989 by Doctrinal Principles for Army Aviation in Combat Operations (under the same FM designation), continuing a lineage tied to the 1976 FM 90-1. The 1989 manual still serves as the "doctrinal foundation of aviation maneuver."¹⁰

The first attack helicopter-specific doctrinal manual, FM 17-50, Attack Helicopter Operations, was the first in a series of "how to fight" manuals for attack aviation. First published in 1977 and revised in 1984, the "17-" designation reflects the armor branch's proponency for attack helicopter doctrine prior to establishment of an aviation branch.

A more contemporary guidebook to FM 17-50 for attack helicopter tactics, and supplementing the more generic branch doctrine of FM 1-100, was the Army Training and Evaluation Program (ARTEP) 17-385, Attack Helicopter Battalion. This reference served as a checklist of collective tasks attack helicopter battalions would accomplish in the conduct of eighteen notional missions and was the benchmark for teams evaluating attack helicopter unit readiness. FM 1-112, Tactics, Techniques, and Procedures for the Attack Helicopter Battalion (1991) represents the most recent doctrine published concerning employment considerations for the ATKHB. A partner publication to FM 1-112, ARTEP 1-187-30-MTP, Mission Training Plan for the Attack Helicopter Company (1989) establishes the manner in which attack helicopter units, companies in this instance, are trained to meet doctrinal mission requirements.

This collection of references describes both the doctrinal structure of attack helicopter units and prescribed tactics from 1977 through today. Consideration of hardware and the human dimension, as both relate to the force mechanic, are missing.

Fortunately, it is not necessary to rely on historical monographs to obtain technical information on aircraft and ordnance subsystems, from the first AH-1 Cobra through the AH-64 Apache. "-10" operator's manuals for these aircraft still sit on many contemporary aviator bookshelves. On the other hand, aspects of force relating to the attack helicopter force's human dimension, typically treated in historical references, simply do not exist. Thoughtful insights from a personal perspective on the Gulf War are just now appearing, many presenting a "global" look at Desert Storm without delving into the details of any particular subordinate force. Again, lessons learned in after action reports and unit histories should help, but lack the objectivity and perspective time allows.

Finally, papers collected by the U.S. Army Aviation Center as, Group Scales Reports: Army Aviation in Operation Desert Shield/Storm,¹¹ offers valuable insight to the reconnaissance, lift, and attack operations accomplished by Army aviation units participating in that war. Specifically, the section which discusses attack missions offers "blow-by-blow" accounts of eighteen engagements by attack helicopter battalions, their employment methods, command and control considerations, fire distribution, weapons and aircraft mixes, and a discussion of the threat.

Target

The primary mission of ATKHBs is to destroy massed enemy forces with aerial firepower, mobility, and shock effect.¹²

in FM 1-112, Attack Helicopter Battalion, July 1986

The mission of an ATKHB is to destroy massed enemy mechanized forces and other forces with aerial firepower, mobility, and shock effect.¹³

in FM 1-112, TTP for the Attack Helicopter Battalion, February 1991

These quotations leave little doubt about what attack helicopter battalions, the *force*, are targeting: massed enemy forces. The 1991 version of FM 1-112 amplifies the target to specify "mechanized" forces, with experience suggesting armored formations also a part of this "mechanized" target.

Once again, American doctrine arguably provides the most complete picture of how a massed mechanized target might present itself to an attack helicopter operation. FM 100-2-1, The Soviet Army: Operations and Tactics; FM 100-2-2, The Soviet Army: Specialized Warfare and Rear Area Support; and FM 100-2-3, The Soviet Army: Troops, Organization, and Equipment served the Army through the fall of the Soviet Union as the "definitive source of unclassified information on Soviet ground forces."¹⁴ These are the threat manuals which guided attack helicopter unit training through the 1980s and prepared them for the Gulf War against a Soviet semi-surrogate.

Counteraction

Unfortunately, America's Gulf War antagonist, the only significant conventional threat to ever present itself to a modern U.S. attack helicopter force, has not seen fit to draft significant comments regarding her counteraction against U.S. air power. Soviet-style air

defense is well outlined in the FM 100-2-series mentioned above and will serve as the principle counteraction source for this study.

Conclusion

The study's research question necessarily requires a review of literature related to both submarine wolf pack and modern attack helicopter operations. World War II wolf pack analysis is further divided into a review of both Atlantic and Pacific theater references. Histories of this conflict are numerous, ranging from "global" histories to memoirs of specific units or forces. Periodicals and government-funded research supplement these references with substantial volumes of information.

The attack helicopter force, significantly younger than the submarine as an organized combatant, suffers an associated "literature gap," necessarily filled by a number of well-documented doctrinal and technical manuals. Luckily, these are easy to locate. The Gulf War represents the limits of America's modern combat experience in a mid- to high-intensity conflict, with only preliminary histories and unit after action experiences available to analyze attack helicopter actions.

Despite these differences in available literature, sufficient documentation appears available to adequately assess the *force, action, target, and counteraction* for both the World War II submarine wolf pack and modern attack helicopter battalion.

CHAPTER 3

RESEARCH METHODOLOGY

Introduction

This chapter completes "setting the stage" by outlining methods that transform information from the reference materials highlighted in chapter 2 to insights on the central research question:

Is there a parallel in the tactical employment of World War II wolf packs and modern attack helicopters?

An exploration of the similarities and differences between these two forces to arrive at a "yes," "no," or "partially" answer, suggests a comparative study. Chapter 1 presented four battlefield mechanics: *force, action, target, and counteraction* as a proposed analysis framework, which the second chapter employed as a means of organizing applicable literature. Chapter 3 describes how these sources help to develop "pictures" of the battlefield mechanics as they apply to both the submarine and attack helicopter. An attack helicopter engagement sequence, the *action "picture"* for that force, must subsequently be refined to develop a corresponding sequence for the submarine. Finally, as the author has personal experience with modern attack helicopters, but only peripheral contact with submarine warfare, largely through the literature, the chapter concludes with a description of the author's one week deployment and associated research activities aboard the USS Augusta, SSN-710. Travel aboard the Augusta, a Los

Angeles-class, fast-attack submarine, added personal insight to numerous research references on the World War II submarine experience.

The Comparative Framework

The American Heritage Dictionary defines a comparison as "a statement or estimate of similarities and differences."¹ The battlefield mechanics provide a framework for this comparison and offer categories in which details of the research project are sorted. Determining the degree of similarity between World War II wolf packs and modern attack helicopter forces and tactics, however, is more difficult and requires a more defined analytical method.

The four mechanics provide a macro-comparison. For the action mechanic, it is possible to accomplish a "micro-comparison" using a doctrinal engagement sequence. U.S. Army doctrine defines this sequence in detail for an attack helicopter unit (figure 7). Using this description as the benchmark, it is then possible to compare micro-action of the submarine wolf pack against an intended target. This step-by-step process is influenced significantly by hardware and organization (force mechanic concepts), as well as a detailed evaluation of the target. However, the method by which submarines and helicopters place themselves in firing positions (the engagement sequence) intuitively offers the greatest possibility for determining how the unique environment of sea and air affect the possible parallel in question. Development of an equivalent submarine engagement sequence became a critical research step and is discussed later in this chapter.

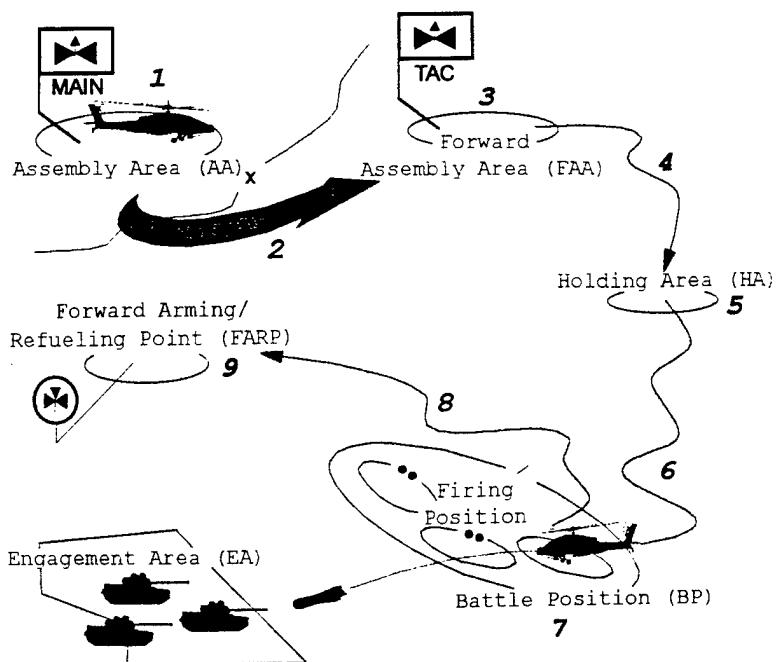


Fig. 7. Representative Attack Helicopter Engagement Sequence. This diagram, and associated actions designated by the numbers throughout the figure, are explained in detail in chapter 5.

Reference Search and Review Methods

Bibliography Trees and Overcoming Reliance on Secondary Sources

Dr. James J. Tritton at the Naval Doctrine Command recommended two works early in the development stages of this thesis: Silent Victory by Clay Blair, Jr., and Stephen Peter Rosen's Winning the Next War: Innovation and the Modern Military. These references, added to those with which the author was familiar, formed the seeds to grow a typical bibliographic tree. In other words, the bibliographies of available works provided branches which revealed additional sources applicable to the study.

This technique is common. However, the nature of warfare, and the manner in which historians and participants record events, offers a unique ability to build even more "authoritative" reference lists. This is particularly important to this thesis because of the heavy reliance on secondary, rather than primary sources. The history available on World War II, and the correspondingly narrow history on modern attack helicopters described in chapter 2, make this additional research technique mostly applicable to the exploration of wolf pack activities.

The literature indicates that soldiers have an almost insatiable desire to explore their wartime experience from the perspective of their enemies. One case, particularly applicable to this work's evaluation of wolf packs, was the writing accomplished by Germany's Admiral Karl Doenitz and Great Britain's Captain Stephen R. N. Roskill. This interplay illustrates how the belligerents help subsequent researchers determine the important World War II secondary sources.

It is impossible to divorce discussion of wolf pack tactics from Karl Doenitz. In 1958, Doenitz, former Commander of the Third Reich's submarine force and eventual successor to Hitler, published his book Memoirs: Ten Years and Twenty Days. In this work, Doenitz quotes from British Navy Captain Stephen R. N. Roskill's The War at Sea (first published in May 1954) on thirty-six different occasions. Roskill, as part of the effort to capture Britain's World War II history, was tasked "to tell the story of maritime war in all its aspects."² In this book, he derived his discussion of the German naval effort from "German archives held by the Admiralty."³ He further commented that, "their

exploitation has been so thoroughly carried out, that little or no guesswork is attached to what I have written about German motives and actions."⁴ Therefore Doenitz's history is built, at least in part, on his knowledge of what Roskill knew about German naval operations which are, finally, derived from German documents outlining operations where Doenitz was a major player.

This single illustration serves to show how an important reference to the study of wolf pack operations, Doenitz's Memoirs, provided insight to another equally critical source. They complement one another in providing each combatant's perspective, describing what their respective intelligence services were reporting about the other, and using both to ultimately present a more objective historical account. Several personal histories, which did not enjoy the broad insight available to Roskill or Doenitz, supplement these resources.

Balancing Broad and Narrow Combat Perspectives

British Commander D. A. Rayner's Escort: The Battle of the Atlantic offers one man's perspective of World War II's naval conflicts. Interestingly, Roskill edited Rayner's book and points out that the book "view[s] tremendous events through the comparatively narrow lens of one man's vision."⁵ A work similar in perspective, Peter Cremer's U-Boat Commander: A Periscope View of the Battle of the Atlantic, offers an interesting contrast to Rayner's Escort. These personal accounts of "hunter" and "hunted" provide the detail often neglected in more broadly-written histories like Roskill's The War at Sea.

Especially for the history of combat, reliance on a single side's account of the action is particularly dangerous. This study therefore concentrated on developing sources which presented each combatant's perspective of the action. A parallel effort ensured sufficient detail, only available in the more narrowly focused works of small unit participants, was balanced against the "big picture" offered in more comprehensive histories.

Search Methods and Note Taking

Lastly, given the significant number of reference materials, a brief explanation of the method used to identify contributing data is relevant. First, the personal accounts mentioned in chapter 2 (i.e., Fluckey's Thunder Below! and O'Kane's Clear the Bridge!) were incorporated. Information pertinent to the analysis was often presented in a very subtle manner which only thorough review and note taking could handle. Broader histories, like those outlining the Battle of the Atlantic or tracing the evolution of helicopter employment since 1945, began with key word glossary searches and expanded as those passages led to other important excerpts. Attack helicopter doctrine was already familiar to the author, allowing a thorough review similar to that accomplished with the personal histories.

This familiarity with attack helicopters highlighted a potential deficiency in the study. Reading a number of World War II submarine histories had already led the author to certain conclusions, based solely on interpretation of a few books and periodicals. This shallow experience, when compared with nearly fourteen years of service

as an aviation officer with extensive attack helicopter service, provided an unbalanced background. The USS Augusta compensated for this shortcoming.

Cruise Aboard the USS Augusta (SSN-710)
28 November--2 December 1995

Lieutenant Commander Kerry D. Ingalls is the Executive Officer aboard the USS Augusta (SSN-710) and the author's brother. He coordinated a five-day cruise for the author from Groton, Connecticut to Roosevelt Roads, Puerto Rico. In response to this unique opportunity, the author accomplished three actions to prepare for the trip: (1) completed a review of all attack helicopter doctrine immediately before sailing, (2) scheduled a class which allowed an opportunity to explain attack helicopter operations and this thesis to Augusta's officers, and (3) read Admiral Richard O'Kane's Clear the Bridge! while aboard.

Experimental Design

Finishing a review of appropriate attack helicopter doctrine provided a basis of comparison between the submarine and helicopter experience. During this review, the author identified the engagement sequence mentioned earlier in this chapter and developed it as a handout for use during the cruise and scheduled training. During the seminar outlined below, participants used the attack helicopter sequence to derive a similar engagement sequence for the submarine. Chapter 6 presents this analysis.

An officer training session (figure 8) provided a forum to discuss the author's trip; introduce Army aviation, attack helicopter

operations, and this thesis; and provided a joint training opportunity for everyone involved. This effort was the groundwork for continued

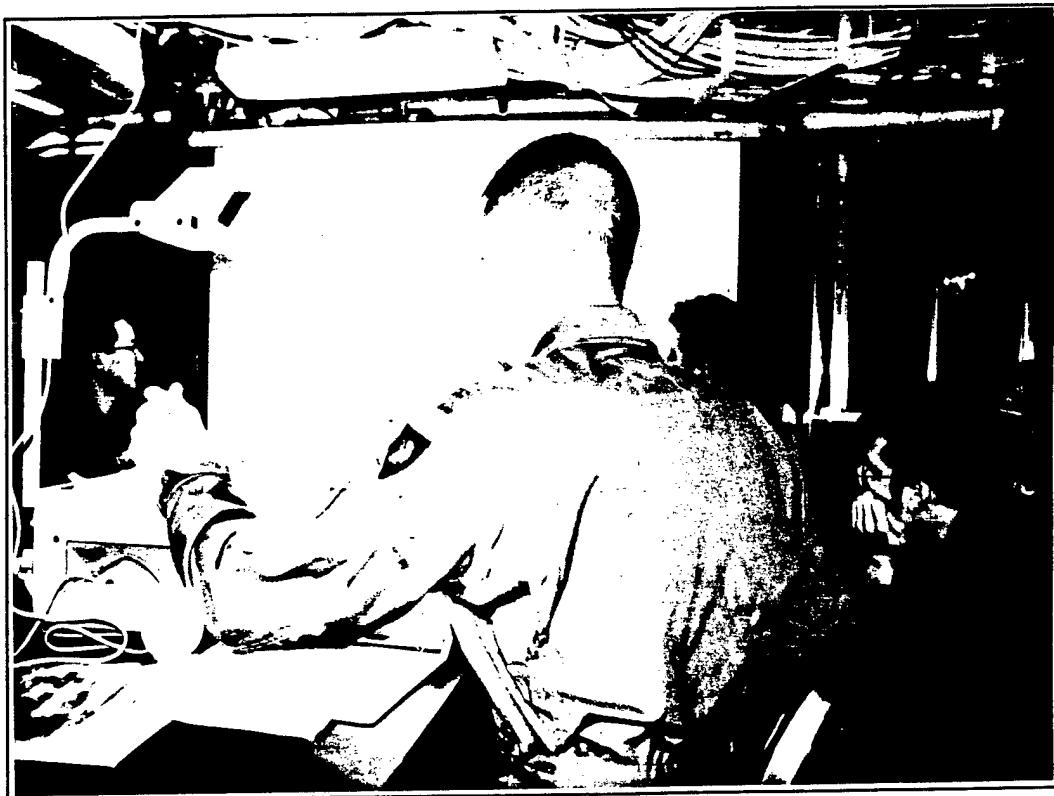


Fig. 8. The author presenting a class on attack helicopter operations and his proposed comparison of modern attack helicopter tactics to World War II wolf pack operations aboard the USS Augusta (SSN-710) on 29 November 1995.

discussion of the submarine-helicopter analogy throughout the remainder of the week.

Reading Clear the Bridge! while aboard Augusta allowed a comparison of submarine operations in World War II to present. Apart from the differences in propulsion, there appear to be striking similarity between operations and activities O'Kane described and experiences aboard Augusta. This 1995 experience, and its similarity to

events resources described about submarining during the 1940s, significantly increased the author's appreciation for descriptions offered by authors like Cremer, O'Kane, and Fluckey.

Final Thoughts

The research question requires analysis using a comparative methodology, which chapter 1 broadly developed. This chapter's discussion of an engagement sequence, and its intended use, refine that analytical framework. References, particularly for the analysis of the wolf pack, allow building knowledge from both belligerents of a combat action and from tactical and strategic perspective. Lastly, the intended comparison of attack helicopter to submarine tactics, and necessity for an Army aviation officer to draw conclusions with respect to this comparison, lends itself to false reasoning and oversimplification. Although neither of these pitfalls are completely overcome, a week's cruise aboard a U.S. Navy submarine provided the author valuable insights regarding interpretation of the World War II submarine force literature.

CHAPTER 4

THE WOLF PACK EXPERIENCE IN WORLD WAR II

Introduction

On April 10, 1917, Rear Admiral William S. Sims, a United States Navy observer in Great Britain, met with Admiral Sir John Jellicoe, Commander-in-Chief, Grand Fleet, to discuss neutral and British shipping losses of the past several months.¹ Both men estimated that Britain's survival was in doubt, a condition created by Germany's expanded guerre de course with her increasingly effective submarine force.

Although previously debated and discarded, one of the anti-submarine measures the British considered was implementation of a convoy system. Initiated earlier in the year on January 10, an experimental convoy system involving forty-five colliers (coal carrying ships) and three to four armed escorts had, by April, resulted in 2,595 of 2,600 vessels reaching France in what was previously considered prime hunting ground for Germany's submarines.² By November 1917, 90 percent of all British shipping was sailing in convoy.³

Admiral Karl Doenitz, a World War I U-boat commander and eventual commander of all Third Reich submarine forces, described the convoy system's effect:

In the First World War the German U-boat arm achieved great successes; but the introduction of the convoy system in 1917 robbed it of its opportunity to become a decisive factor. The

oceans at once became bare and empty; for long periods at a time the U-boats, operating individually, would see nothing at all; and then suddenly up would loom a huge concourse of ships, thirty or fifty or more of them, surrounded by a strong escort of warships of all types. The solitary U-boat, which most probably had sighted the convoy purely by chance, would then attack, thrusting again and again and persisting, if the commander had strong nerves, for perhaps several days and nights, until the physical exhaustion of both commander and crew called a halt. The lone U-boat might well sink one or two of the ships, or even several; but that was but a poor percentage of the whole. The convoy would steam on. In most cases no other German U-boat would catch sight of it, and it would reach Britain, bringing a rich cargo of foodstuffs and raw materials safely to port.

Against the massed ships of a convoy, then, obviously the only right course is to engage them with every available U-boat simultaneously.⁴

In this quotation Doenitz describes the submarine's dilemma and proposes his solution; pack tactics.

Nearly twenty-five years later, American submarine forces in the Pacific would begin wolf pack operations using rationale very similar to the Germans. Captains Charles B. "Swede" Momsen (Commander, Squadron 2) and John H. "Babe" Brown (Commander, Squadron 4) persuaded Admiral Charles A. Lockwood, Commander, Pacific Submarine Forces, to try pack tactics.⁵

Japanese convoys were becoming larger and better organized with stronger escorting forces, including, in some cases, small carriers. Experience had proven that the submarine force needed more firepower to break up a big convoy. Brown and Momsen argued - logically - that several boats operating against a convoy not only brought more firepower to bear but also tended to be mutually supporting defensively: one boat could draw away escorts holding down and pounding another.⁶

Historians record 152 U-boat patrol groups, which typically splintered into several subordinate packs to operate against Allied merchants, and 117 U.S. submarine wolf packs organized to bring Japanese shipping to her knees. While Doenitz, Momsen, and Brown presented

similar arguments for adoption of the pack tactic, each force's wolf packs were distinct, applied against different target arrays, and, due to the differences in countermeasures employed against them, experienced radical differences in their ultimate success.

This chapter explores wolf pack organizations, submarines and weapon systems, escort forces, and their corresponding systems (the force); tactics employed by both Germans and Americans using pack formations (the action); a description of convoys in both theaters (the target); and procedures adopted by convoys and their escort forces to counter massed submarine attacks (counteraction).

Discussion of each battlefield mechanic will begin with the German approach, followed by evaluation of the same mechanic from an American perspective, and conclude with a comparison in order to draw general conclusions regarding World War II wolf packs. These conclusions are necessary to develop the intended comparison with modern attack helicopter tactics.

The Wolf Pack Force

Die U-Bootswaffe (The Submarine Force)

As Germany initiated her attack against Poland in the early hours of September 1, 1939, only sixteen U-boats (eleven Type VII/VIIB ocean-going, five Type IIC coastal) sat in the North Atlantic awaiting Britain's shipping.⁷ The time Admiral Karl Doenitz had expected to prepare for a war with Britain was gone and his admonishments to the German and Naval High Commands to increase U-boat construction finally

received approval, albeit at the "eleventh hour," as Grand Admiral Erich

Raeder:

immediately gave orders that all work on capital ships not yet actually launched should cease forthwith, that the building programme envisaged in the Z Plan should be suspended and that the construction of the types and numbers of U-boats proposed by [Doenitz] . . . should be taken in hand at once and as a matter of extreme urgency.⁸

At its zenith, the U-bootwaffe had 449 operational vessels under its command, although only 214 (48 percent) of that number were considered "frontboote," boats for service in the Atlantic, Mediterranean, or North Sea areas.⁹ Of these, the 704 Type VII through VIIF submarines constituted roughly 61 percent of all submarines Germany built from 1935 through 1945.¹⁰ These were Doenitz's primary wolf pack weapon.

The Type VII U-Boat

As early as the Summer of 1935, Doenitz began wrestling seriously with the issue of building the best possible submarine for use during the next war. Considerations of diving and surfacing times, maneuverability near the surface (required for torpedo attacks), silhouette, and radius of action led German Naval leaders to the conclusion that a boat "of some 500 tons"¹¹ was most appropriate. Doenitz recounts that in 1935, three U-boat types were available or under construction (table 1). Very nearly meeting Doenitz's criteria, Germany selected the Type VII for further development.¹² His simultaneous consideration of pack tactics also resulted in his conclusion that "the handy and fast Type VII was particularly suitable."¹³

Concerned with its radius of action, Doenitz set his engineers about the task of modifying the Type VII's current design. Captain Thedsen, the U-Boat Force's Chief Engineer, suggested optimizing space in the current design and increasing size by 17 tons. These

TABLE 1

CHARACTERISTICS OF U-BOATS IN SERVICE OR UNDER CONSTRUCTION IN THE SUMMER OF 1935

	U-Boat Type		
	Type I	Type II	Type VII
Displacement [tons]...	712	250	500
Bow Torpedo Tubes.....	4	3	4
Stern Torpedo Tubes...	2	0	1
Surface Speed [kts]...	17.7	13.0	16.0
Submerged Speed [kts].	8.2	6.9	8.0
Radius of Action [nm].	7,900	3,100	6,200

Source: Karl Doenitz, Memoirs: Ten Years and Twenty Days (Annapolis, Maryland: Naval Institute Press, 1990), 29. Displacement is calculated using the "displacement" formula agreed to by signatories of the Washington Treaty of 1922 and does not include fuel and oil supplies. The Type VII, including these provisions, would represent a vessel of approximately 700 tons.

modifications would allow carrying 108 additional tons of fuel oil, increasing the boat's radius of action to approximately 8,700 nautical miles.¹⁴ Twenty-four Type VIIB (the Thedsen modification) U-boats were ultimately built as one of five different variants which saw action throughout the war.

Doenitz also recommended an additional U-boat version of approximately 740 tons, developed with a "radius of action between twelve and thirteen thousand miles for independent operations far afield."¹⁵ His comments regarding the Type VII's desirable characteristics for joint action and the associated recommendation to build a larger boat for "independent operations" indicate the Type VII was the U-bootwaffe's choice for pack tactics. Table 2 provides selected characteristics of all Type VII versions.

TABLE 2
SIGNIFICANT SPECIFICATIONS OF TYPE VII
U-BOAT VARIANTS

	VII	VIIB	VIIC/C41	VIID	VIIF
Number Constructed.....	10	24	660	6	4
Surface Displacement [tons]....	626	753	769	965	1,084
Submerged Displacement [tons]..	915	1,040	1,070	1,285	1,345
Length [ft].....	211.6	218.2	218.2	252.3	254.7
Beam [ft].....	19.2	20.3	20.3	20.9	23.9
Keel to Bridge [ft].....	31.2	31.2	31.5	31.8	31.5
Draught [surfaced].....	14.3	15.6	15.6	16.4	15.4
Surface Speed [kts].....	16-17	17.2-17.9	17-17.7	16-16.7	16.9-17.6
Submerged Speed [kts].....	8.0	8.0	7.6	7.3	7.9
Dive Depth [ft].....	328	328	328	328	
Dive Time [sec].....	50	30			
Crush Depth [ft].....	656	656	656	656	
Torpedo Tubes [fwd/aft].....	4/1	4/1	varied	4/1	4/1
Crew.....	44	48	60	44	46

Source: David Westwood, The Type VII U-Boat (Annapolis, Maryland: Naval Institute Press, 1984), 11-13.

Communications

While the submarine is sometimes considered a solitary weapon, operating on and in the vastness of the world's oceans, "Ali" Cremer,

commander of U-333 throughout much of the war, commented that despite the "blue depths, we never felt alone, but rather as a tightly knit family continually connected with the great U-boat clan on shore."¹⁶ Radio was the capability which connected these boats with Doenitz and facilitated coordinated operations.

David Westwood's book, The Type VII U-Boat, shows only the long aerial stretching from bow to stern, but does not discuss specifics of the communications equipment on board. Cremer said that "the air was humming in the short-wave band from 100 to 40 metres [high-frequency (HF), 3-30 Megahertz (Mhz)] and in the long-distance traffic from 40 to 13 metres."¹⁷ These notes imply U-boats used HF receivers/transmitters and communicated "locally" or "long-distance" on distinct frequencies. U-boat command communicated with boats operating as far away as the Caribbean and New York using "an ultra-long-wave transmitter . . . built in central Germany."¹⁸ Cremer noted these transmissions occurred on the 10,000 meter band (low - very-low frequency (LF-VLF)).¹⁹

Cremer's insights regarding the capabilities of his Type VIIC U-333 indicate Doenitz arrived at answers to his pre-war questions regarding the operational wave-length his boats should operate on, the ranges of these communications, and their impact on command and control of wolf pack operations.²⁰ Command and control is addressed later in this chapter.

The G7e Torpedo

The 1943 version of The U-Boat Commander's Handbook highlights that, "The primary purpose of the submarine . . . is the surprise

underwater attack."²¹ "For the torpedo-firing submarine, the gunnery [sic] is and remains a minor weapon."²² In fact, unrestricted submarine warfare largely rendered a deck gun obsolete and anti-aircraft systems replaced most by 1942. Of the submarine's weapons therefore the torpedo was dominant and of the torpedoes used by German U-boats throughout World War II, the G7e variants was most prevalent.

Although initially provisioned with G7a torpedoes, propelled by compressed air that left a distinct track hunted vessels could use to determine the submarine's relative bearing, these were quickly replaced in favor of the G7e, electrically-propelled weapons. These torpedoes, without the bubble-track, increased the submarine's stealth characteristics during an attack. Specifications of the five G7e versions are highlighted in table 3. Torpedo basic load of the Type VII varied with the submarine version, from eleven the basic Type VII carried, to twenty-three aboard the Type VIIF.

TABLE 3
GERMAN SUBMARINE TORPEDOES

Type	Propulsion	Range [m]	Speed [kts]
G7a	T1 : compressed air	800-14,000	30-44
G7e	T2* : electric	5,000	30
	T3 : electric	5,000	30
	T4 : electric	7,500	20
	T5 : electric	5,700	24
	T11 : electric	5,700	24

*the G7e T2 was the standard war torpedo. Source: David Westwood, The Type VII U-Boat (Annapolis, Maryland: Naval Institute Press, 1984), 14.

Shooting torpedoes required aiming the whole submarine, opening a vent to allow water into the tube in order to equalize pressure to that of the surrounding ocean, and opening the torpedo tube outer casing doors before turning the Kirek torpedo firing lever²³ and sending the weapon on its way. A ship's natural magnetic field was intended to detonate the three hundred kilograms (661 lbs)²⁴ of high explosive via the electric proximity pistol in the warhead. The Germans later added pattern-running devices which ultimately produced "a 'surface-searching' torpedo with pre-programmed zig-zag course."²⁵ These "fish" would wander with "regular 180° turns"²⁶ and were more likely to find a target inside the more densely-packed convoy formations.

The Type VII U-boat armed with up to twenty-three G7e torpedoes became therefore the wolf pack's basic building block.

The Wolf Pack

The wolf pack's objective was "to locate the enemy, to report his position, and to attack him with the greatest possible number of U-boats."²⁷ Organizations formed to facilitate a wolf pack attack begin speaking to the *action* mechanic, but lend insight to the *force* organized to locate and report, as well as the attacking "pack" most think of when discussing massed U-boat tactics of the Second World War. In addition, pack organizations required a command and control structure to properly coordinate the massed submarines.

To accomplish the "location" mission, Doenitz organized "reconnaissance or lookout formations."²⁸ Chronology of the War at Sea 1939-1945, Defeat of the Wolf Packs, and U-Boat Commander provide

complementary perspectives which describe these force dispositions against the combined convoy MKS.30/SL.139.

"On 13 November [1943] agents report the departure of convoy MKS.30 from Gibraltar. It joins SL.139 on 14 November and then consists of 66 steamers and the 40th EG [Escort Group]."²⁹ In response to a "precise report of the strength and course of the convoy,"³⁰ Doenitz had directed the formation of three patrol groups: *Schill I*, *II*, and *III* consisting of eight, ten, and eight U-boats, respectively (figure 9).

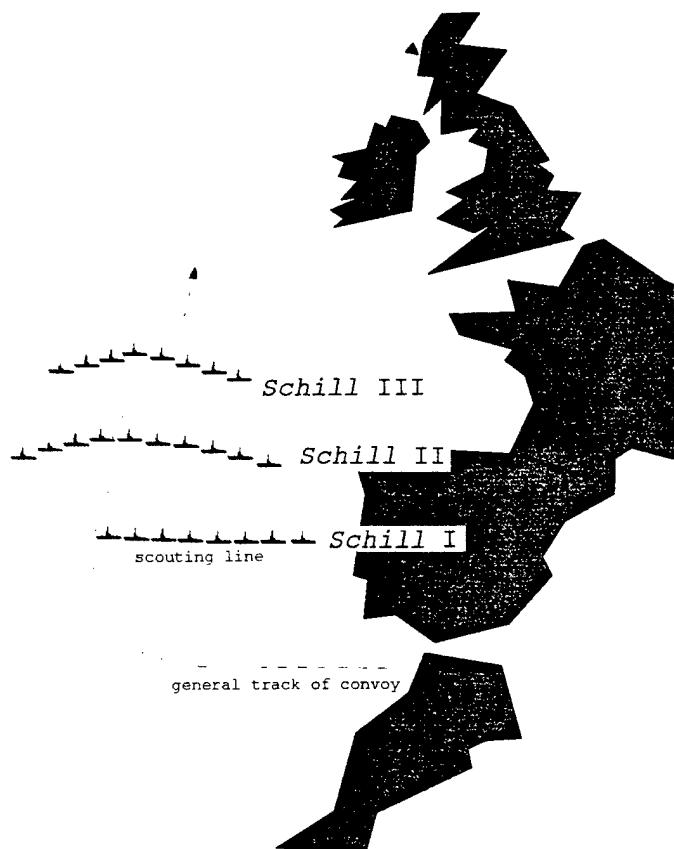


Fig. 9. U-Boat dispositions for intercepting convoy SL.139/MKS.30.
Source: Geoffrey P. Jones, Defeat of the Wolf Packs (Novato, California: Presidio Press, 1987), 56.

Doenitz's Memoirs discusses these three lines of U-boats:

For reconnaissance and screening duties we adopted the old torpedo-boat tactics as our god-parent. A start was made by organizing reconnaissance or lookout formations. When an enemy was sighted, the U-boat making the sighting, having signalled the presence of the enemy, at once attacked, followed as quickly as possible by the other U-boats. This method could be used only against an adversary of speed inferior to our own. It was therefore supplemented by the organization, behind the scouting line, of one or more groups whose task it would be to operate against any enemy whose presence was reported.³¹

In the action against MKS.30/SL.139, *Schill I* therefore represented the reconnaissance line while *Schill II* and *III* are the "one or more groups" referred to, which would attack the convoy after its intercept.

The patrol groups dispersed their boats at sufficient interval to overcome the Admiralty's propensity to "make long detours,"³² especially appropriate in the case of convoy MKS.30/SL.139 after having been located and circled by a Junkers 290 aircraft for nearly thirty minutes on November 15.³³ In this case, where U-boat Command had received notification of the convoy's sailing and had formed three patrol groups to intercept and destroy it, boats were likely dispersed and operating initially from "waiting stations." These "are defined in the instructions (order) in squares of a certain depth [radius]."³⁴

These squares, ocean subdivisions designated by the German Navy, carried a letter identifier and were further subdivided to the level of resolution desired for a given operation (figure 10). Direction toward an action station might therefore read something like-- waiting station, square BD99, depth 10 sm (statute miles). This describes a five statute mile radius circle centered on the middle of

naval square (marinequadrat) BD99. Patrol groups ordered by U-Boat Command to waiting stations without specifying the boat to occupy each station would position submarines in numerical order, the lowest numbered U-boat taking the station first indicated in the message. Further details would indicate the date and time by which all boats must occupy their assigned waiting stations.³⁵

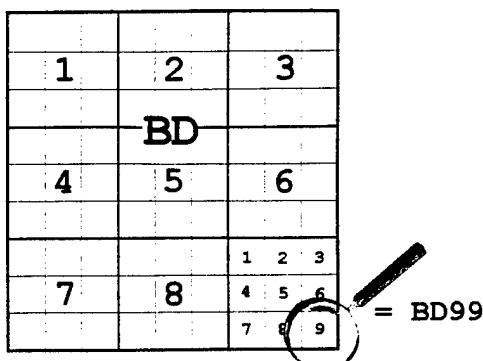


Fig. 10. Schematic of ocean subdivisions using the marinequadrat (naval square). Source: Michael Gannon, Operation Drumbeat (New York: Harper & Row Publishers, 1990), inside cover.

The second major grouping of submarines, the "one or more groups" highlighted above, is the element most would think of when referring to wolf packs: the killing groups. Cremer observed U-boats massing in packs of "6, 8, 15 and more."³⁶ Whether these were the reconnaissance formations or "operating" groups is immaterial as any submarine capable of engaging the convoy from either formation was doctrinally directed to do so.³⁷

Although not addressed specifically in the U-Boat Commander's Handbook, those submarines not in contact, i.e., those boats who were assigned subsequent lines (Schill II and III), likely operated within

areas similar to "waiting stations" described in the previous section.

A more detailed account of these locations is handled under the action mechanic.

These formations, however, were arrayed in a slightly different manner than the reconnaissance line, whose mission was to gain contact and refine information regarding convoy location, speed, escort forces, and weather. These important enemy updates allowed subsequent U-boat patrol groups to concentrate on a more narrow front, allowing more submarines the opportunity to maneuver against the approaching convoy from as short a distance as possible. Doenitz highlights:

Tactical formations of the most varied character were tried out in a very large number of training exercises and manoeuvres, and from them there eventually emerged a formation in a concave curve. Into this the enemy would penetrate, the U-boat which first sighted him would maintain contact, while the U-boats on the more distant rim of the curve would act as a support group.³⁸

The concave formation would result in a smaller distance to travel for U-boats on the periphery from the point of contact and the convoy, increasing the number of boats able to close on the group within a finite period of time (figure 11).

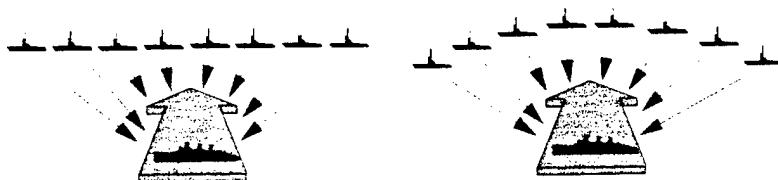


Fig. 11. Effect of utilizing a concave vs. straight patrol line. In this very simplistic representation, note the outer boats travel a shorter distance in the concave formation to close with the target.

"The success, or otherwise, of the attacks of all the other submarines operating against the convoy depends on the skill of the first submarine."³⁹ Likely the most important organizational component, these "contact holders," defined in the U-Boat Commander's Handbook as the first two boats to transmit contact reports,⁴⁰ linked the reconnaissance and attack formations and are the third piece of a wolf pack's organizational structure.

Command and Control

During his trial at Nuremberg, Doenitz reflected on three critical concerns with respect to waging war on the enemy's commerce using submarines. His solution to one of these, how to command and control submarines operating together, changed from a local focus to centralized control as the war progressed.⁴¹

Early experience with pack operations during fleet maneuvers in 1937 highlighted that the "conduct of group tactics on the high seas was not practical without a headquarters vessel, specially equipped with the requisite means of communication."⁴² The proposal to construct such a ship, ultimately the Erwin Wassner, met with resistance owing to the Naval High Command's opinion that the U-boat was designed to operate independently. Only Raeder was able to counter the naval staff's position.⁴³ Rohwer and Hummelchen's Chronology, however, lists the Erwin Wassner in only one citation, its sinking during bombing raids on Kiel in late July 1944⁴⁴ and there is no indication the headquarters vessel ever made it into the Atlantic where Doenitz envisioned the great convoy battles.

Instead, when Doenitz initiated pack tactics against Gibraltar shipping in October 1939, he sent a senior U-boat officer, Commander Werner Hartmann, to sea in U-37 as the tactical commander.⁴⁵ The 1943 version of the Handbook for U-Boat Commanders limits authority of the pack commander to "taking steps to relocate the enemy, when contact has been lost; for example, by organizing reconnaissance or advance patrols."⁴⁶ Whether these limitations were in effect for Hartmann's cruise with the first wolf pack is unknown, although Doenitz does reveal:

If in his opinion the area off Gibraltar appears to offer little prospect of success he may use his own discretion and move to an area a little further away from enemy bases, somewhere along the length of the Spanish-Portuguese coast.⁴⁷

These instructions appear consistent with later guidelines for group commanders.

Early experience did not reaffirm the necessity of exercising tactical command over pack operations at sea. Lessons learned during the October 1939 convoy engagements showed:

To be able to remain on the surface in order to direct operations the subordinate commander in tactical control had to remain far enough away from the convoy to be beyond the reach of its escorting aircraft. But if he did this he was out of sight of the convoy and was therefore robbed of the essential 'on the spot' information and power of observation. If on the other hand he remained closer to his objective, he would be forced to observe the same defensive precautions as any other U-boat in action. In addition, with only a very small number of U-boats available for any operation we could hardly afford to reduce our striking force by detailing one of them for special command duty.⁴⁸

Very early in the war therefore Doenitz decided to return these senior commanders to training responsibilities required to get the U-bootwaffe prepared and to "direct the whole tactical operation against a convoy

from my headquarters ashore."⁴⁹ Control by "Submarine Command," according to the Handbook, always took precedence over any local command structure.⁵⁰

United States Navy Wolf Pack Forces

On September 26 [1943] two submarines left home base at Pearl Harbor and headed west for Midway. At Midway they were joined by a third submarine. The three departed together on October 1st - destination, the East China Sea. This was the first American wolf pack of the war.⁵¹

This patrol was a long time in the making. The Navy explored section tactics during the 1930s, conducted trials of simultaneous night surface attacks in 1941, and tested trial pack tactics and procedures against American supply convoys en route to Pearl Harbor.⁵² These tests were the Navy's attempt to resolve two contentious issues related to the wolf pack tactic: tactical communications and fire distribution.

Unlike Doenitz, American naval leaders had long thought the wolf pack's requirements for frequent communication between attacking submarines, and commensurate risk of radio detection, outweighed the capability gained by massing for a wolf pack attack. Doenitz was convinced Allied radio detection was a fair price to pay for overwhelming firepower concentrated against merchant convoys. History indicates he was correct, at least until 1943 when the Allied anti-submarine effort matured enough to effectively counter Germany's submarine threat.

On listening to the patrol reports of two submarines operating in close proximity to each other near Truk, Richard O'Kane, commander of the USS Tang, commented that their operations had demonstrated the

ability to operate in cooperation, so long as strict fire control measures were instituted to ensure one boat did not shoot the other.⁵³ History will indicate the issue of fire distribution, closely related to tactical command and control in the vicinity of a convoy engagement, were never solved by either force (Germans or Americans).

Concerns over fire control and communications in the target area aside, "experiments [with pack tactics] led to the formulation of a standard coordinated attack doctrine."⁵⁴ Two of the three boats to first exercise this new doctrine, the USS Cero and USS Shad (the USS Grayback, SS-208, was an older Gar-class boat), were Gato-class submarines, "the prototype of all wartime U.S. submarines."⁵⁵

Gato-Class Submarines

Pre-war submarine building strategies failed to foresee the coming antishipping efforts, not surprising given the submarine force itself rambled on until 1943 with no coherent employment strategy. Prevailing thought considered Japan the most obvious Pacific threat and considered submarines either as strategic scouts, deployed off a Japanese anchorage to track and report fleet movements, or as security forces scouting for the fleet.⁵⁶ "Yet, after Pearl Harbor, it turned out that the characteristics developed for fleet support were exactly those required to attack Japanese shipping."⁵⁷

The primary considerations which drove submarine design to the Gato-class were range sufficient to operate from Pearl Harbor against Japan, space for adequate provisions and torpedoes, and adequate crew comforts felt necessary for both peacetime training and the rigors of

long patrols. The result was a series of submarines of between 1,350 (Perch-class) to 1,526 tons (Gato-class), much larger than the Type VII German U-boat (approximately 800 tons surface displacement--Type VIIC/C41).⁵⁸

In U.S. Submarines through 1945, Norman Friedman identifies developing classes of American submarines with fiscal years (FY), the Gato-class associated with FY41. The larger number of Gato submarines produced benefited from a combination of its design's timing with American alarm over the fall of France. During FY39 (Tambor-class), six submarines were approved for production; FY40 (Gar-class), another six; with 71 boats approved during FY41 (Gato-class).⁵⁹ Characteristics of these class boats are compared to the Type VIIC/C41 U-boat below (table 4).

The comparison (table 4) is skewed in that American submarine technology lagged behind the Germans. "Postwar analysis suggested the Germans achieved more on a given tonnage thanks to three factors: (1) lighter (short-life) batteries, (2) lighter engines, and (3) some improvement in hull structure.⁶⁰ In addition, habitability aboard a captured Type VII (U-570) was judged worse than American submarines, hence less tonnage was devoted to crew comfort.⁶¹

Design considerations as early as 1930 included the requirement for long-range communications. Communications at ranges of 7,900 nautical miles were demonstrated by older S-class submarines in February 1930 and a three-foot vertical antenna pushed above the water's surface was demonstrated at 2,000 nautical miles.⁶² A short-range radio known as TBS (talk-between-ships) was envisioned for use with the first wolf

pack. TBS predominantly used code to communicate.⁶³ The concern over Japanese radio direction-finding, the number of sinkings jointly

TABLE 4

COMPARISON OF THE AMERICAN GATO-CLASS SUBMARINE
TO THE TYPE VIIC/C41 U-BOAT

	Gato-class	VIIC/C41
Number Constructed.....		660
Surface Displacement [tons]....	1,526	769
Submerged Displacement [tons]..	2,410	1,070
Length [ft].....	311.8	218.2
Beam [ft].....	27.3	20.3
Keel to Bridge [ft].....		31.5
Draught [surfaced].....	15.3	15.6
Surface Speed [kts].....	21.0	17-17.7
Submerged Speed [kts].....	9.0	7.6
Dive Depth [ft].....	300	328
Surface Endurance [nm/kt]....	11,000/10	8,500/10
Submerged Endurance [nm/kt]...	96/2	130/2
Torpedo Tubes [fwd/aft].....	6/4	varied
Crew [officer/ratings].....	6/54	4/56

Source: Norman Friedman, U.S. Submarines through 1945 (Annapolis, Maryland: Naval Institute Press, 1995), 311 and David Westwood, The Type VII U-Boat (Annapolis, Maryland: Naval Institute Press, 1984), 12.

credited to submarines operating against the same convoy, as well as Gene Fluckey's descriptions of convoy engagements in Thunder Below!, would indicate these types of radio communications (i.e., to control and distribute fires), especially during engagements, were rare.

Radio, however, was not the only means of communication. In Clear the Bridge!, Richard O'Kane discusses Tang's rendezvous with other submarines at night in order to coordinate operational details or to

exchange spare parts. These types of boat-to-boat communications included pre-arranged sound pings using sonar systems and light guns. While none of the circumstances O'Kane described involved impending wolf pack attacks, these methods were available and probably used at some point by one of the one hundred plus wolf packs.

Torpedoes

Friedman's work on U.S. submarine development highlights the degree to which the German undersea technological advantage drove America. As an example, "In 1942, Westinghouse Electric Co. was ordered to copy the German G7e [torpedo] recovered from the captured U-570."⁶⁴ The Mark (Mk) 18 (4,000 yards @ 29 knots) appeared fifteen months later.⁶⁵ Like the Germans, American commanding officers enjoyed the advantages of a wakeless weapon. In 1944, thirty percent of all torpedoes fired were Mk 18s, increasing to 65 percent in 1945.⁶⁶

Prior to 1944, the Mark XIV torpedo was dominant. Like its German counterparts, the Mk XIV employed a magnetic pistol, intended to detonate when activated by the magnetic field characteristic of ships. Pistol problems similar to those experienced by the Germans beginning in the Norwegian campaign surfaced and were not corrected until well into 1943.⁶⁷ The Mk XXIII, a single-speed version of the Mk XIV, was later introduced to simplify production.⁶⁸ Characteristics of the Mk 14 and Mk 18 are compared with the G7a and G7e torpedoes in table 5.

Gato-class submarines carried twenty-four torpedoes⁶⁹ with post-war analysis indicating most attacks averaged three torpedoes per salvo.⁷⁰ While the wakeless Mk 18 provided commanders a stealth

advantage, the slower speed often resulted in a target maneuvering to avoid the impact. Engagement ranges increased nominally (to 2,660 yards surfaced/2,150 yards submerged) with the Mk 18. Throughout the war, the Mk 14 and 18 exhibited a 33.5 percent hit rate when fired singly, and a 57.5 percent success rate when fired in salvo.⁷¹

TABLE 5
AMERICAN/GERMAN TORPEDO COMPARISON

	G7a German	Mk XIV American	G7e T2 German	Mk XVIII American
Propulsion...	compressed air	compressed air	electric	electric
Range [m]....	800/6,000	4,115-4,572	5000	3658
Speed [kts]..	40/44	45	30	29

Source: Norman Friedman, U.S. Submarines through 1945 (Annapolis, Maryland: Naval Institute Press, 1995), 165 and 243 and David Westwood, The Type VII U-Boat (Annapolis, Maryland: Naval Institute Press, 1984), 14.

American Packs

American wolf packs barely resembled the larger formations of submarines employed by the German navy in the Atlantic. Experiments with the tactic "held that an attack group of three submarines would be adequate against the average Japanese convoy."⁷² In fact, of the 117 packs organized and employed during the war, two-thirds were three boats.⁷³

The limited number of boats precluded German scouting and attack lines (figure 9) and the use of a concave line was less important with only three submarines (figure 11). In order to maximize the search area, "distance between submarines was prescribed (for the average

situation) at somewhat less than twice the range of visibility or radar effectiveness."⁷⁴ The USS Haddock's experience in August 1942 with the first SJ radar set indicated ranges of from twelve to thirteen thousand yards (approximately 11 to 12 kilometers)⁷⁵, suggesting boat separation approaching thirteen nautical miles. Boats traveled in column or line formation normal to the expected convoy track (figure 12).

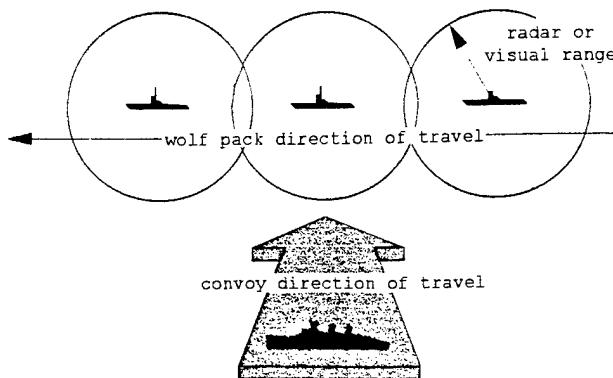


Fig. 12. Typical orientation of an American wolf pack with respect to the target convoy. Source: Theodore Roscoe, United States Submarine Operations in World War II (Annapolis, MD: The United States Naval Institute, 1949), 243.

Command and Control

"Swede" Momsen, who, with "Babe" Brown, had persuaded Admiral Lockwood to try wolf packs, was assigned tactical command of the first pack and sailed with Dave White, the most experienced commander of the group, aboard Cero.⁷⁶ The American experience with wolf pack command and control bears a marked resemblance to the German. Only two wolf packs were conducted before the Americans began to debate the utility of a local tactical commander.⁷⁷ Most wolf packs throughout the remainder

of World War II in the Pacific continued deployment of a senior submarine commander as the group leader, although targets of opportunity often required hasty pack organizations and designation of a commander from among the participating submarines.

Although not explicit in the history, the impression of American wolf packs is that, although they were directed to operational areas in a manner similar to the Germans (i.e., direct assignment from Doenitz's headquarters), tactical commanders were allowed more latitude in directing attacks than was the case in the Atlantic.

Wolf Pack Force Conclusions

Against the big Atlantic convoys, U-boat concentrations had proved all too effective. In the Pacific, oceanic distances were greater, American submarines were relatively few, Japanese shipping was scattered all over the map. And the character of undersea warfare was influenced by these and other factors which differed from those in the Atlantic.⁷⁸

It is safe to assume American naval officers kept a close watch on Doenitz's progress in the Atlantic. Submarine and torpedo development had followed the Germans closely, with the Allies exploiting captured submarines after both world wars. Doenitz had correctly measured both the tactic and weapon necessary to effectively combat Allied shipping in the Atlantic. Opposition to the tactic by American officers in the Pacific theater gradually waned with introduction of a convoy system by the Japanese. The convoy's massed merchant ships, and the submarine's lack of a speed advantage, required a massed response.

As indicated by Roscoe in the quote above, submarines developed in both theaters were reflective of their intended targets and the oceanic environment. Allied shipping toward Great Britain allowed the

Germans to receive their targets, while American wolf packs were required to pursue Japanese shipping operating in the western Pacific. The difference in required operational ranges, as well as American shipbuilding inefficiencies, drove up the tonnage of American submarines.

Wolf pack organizations reflected the number of submarines available to each force, the target, and differences in command and control schemes. Neglecting the older S-class submarines, Americans ultimately employed somewhere between 200 and 250 submarines of the Gato, Balao, and Tench classes throughout the war.⁷⁹ This is in contrast to the 1,131 submarines commissioned by Germany prior to 1944.⁸⁰ Fewer numbers, and the desire to mass submarines, required, as Doenitz understood early during his campaign in the Atlantic, smaller wolf packs. In addition to smaller Japanese merchant convoys, the flexibility given American tactical commanders, as opposed to central direction given German wolf packs, luckily resulted in a need commensurate with the Navy's ability for field pack organizations.

The Wolf Pack's Counterforce - Escort Groups

The Atlantic Theater

When I learnt of the sinkings, I was reminded of a remark made by Commander Howard-Johnston at a conference, when he was asked to what extent a Captain should hazard his own vessel when attacking a U-Boat. Howard-Johnston replied, 'There is no risk yet. The U-Boat is out to sink merchantmen. You are a confounded nuisance to its Captain, not a target.⁸¹

Most combat-proven fighting forces ultimately face these "confounded nuisances," developed specifically to limit the

effectiveness of a specified weapon system or type unit. For the wolf pack, these were the escort groups accompanying merchant convoys.

John Winton's Convoy outlines the history of convoys from 1890 to 1990, and the associated protection necessary to adequately secure their sea lanes. Specific to World War II in the Atlantic is Stephen Roskill's The War at Sea, while a number of authors, including Geoff Jones in Defeat of the Wolf Packs and D. A. Rayner in Escort, concentrate specifically on the Allied effort to counter Germany's submarines.

Recognizing the comprehensive history outlined in these references, this section only intends to describe a typical World War II escort group. After an overview of merchant marine convoys (the target) later in this chapter, the two are related spatially before proceeding with a discussion of counteraction, by both the escort force and convoy, to limit the attacking wolf pack's success.

Escort Group Organization

In The War at Sea, Stephen Roskill explains that by 1939, "The practice of escorting unarmed or lightly armed merchant ships by warships is of very ancient standing."⁸² Learning their lessons from the First World War, Britain instituted the mercantile convoy system on September 6, 1939 along her eastern coast and began ocean convoy operations the following day.⁸³ Forces tasked with the responsibility of convoy escort were distributed among the "four home commands" and consisted mainly of destroyer flotillas.⁸⁴

The Western Approaches command, whose "emphasis was on convoy protection, [was] assigned the 3rd, 11th, 12th and 17th Destroyer Flotillas (thirty-two destroyers in all)."⁸⁵ Early ocean escort typically consisted of two destroyers from one of these flotillas, which would accompany the convoy only an approximate day's sail westward before meeting and escorting another convoy to England.⁸⁶ These missions were accomplished by *ad hoc* formations of naval vessels, with commensurate difficulty in command and control. In Escort, D. A. Rayner explains:

But in January 1941 to be attached to a strange group was to find oneself submerged by a flood of code words which meant nothing to you. If you joined in the middle of the day perhaps you would get details of the more intricate manoeuvres passed to you by flash lamp. Sometimes, you would receive by rocket line a nice folder, parcelled in waterproof cloth, and containing all the group orders properly typed. But such an easy introduction was very rare, because you might be taken away as suddenly as you had joined.⁸⁷

These were some of the problems which led to Western Approaches command's formation of escort groups on October 12, 1940.⁸⁸

As evidenced by Rayner's 1941 experience, formation of these groups was not, by itself, the "end all" solution. The Admiralty had failed to design an effective escort vessel between the wars and naval requirements elsewhere resulted in a shortage of ships available to these organizations. Coupled with the formation of an escort training school in 1942, escort production and the fifty destroyers made available through American lend-lease would ultimately train and equip an effective Allied counterforce.

Arguments concerning the size of convoys, hence the number of required escorts, continued throughout the war, with entire volumes of

operational research accomplished to capture probabilities of detection and sinking by submarine with various formations. However, in describing World War II convoys and their escort forces, most histories ultimately describe the Admiralty's 1941 "solution" of an escort group of from six to eight vessels, supported by an oiler.

By February 1941, twelve escort groups had been formed, most of them consisting of five destroyers, and five sloops or corvettes, so that a convoy could normally expect an escort of at least six to eight ships (allowing for some ships refitting and boiler-cleaning).⁸⁹

Allies would eventually form a total of thirty-six escort groups throughout the war.⁹⁰

Anti-Submarine Weapons

ASDIC

British echo-ranging sound gear, equivalent to United States sonar. Name is derived from Anti-Submarine Detection Internal Committee, which pioneered the development of such equipment.⁹¹

The device, developed between the First and Second World Wars, "consisted of a transmitter-receiver encased in a metal dome fitted under the hull of the carrying vessel."⁹² Rayner notes the positioning was approximately one-third back along the hull to minimize noise from the ship's own movement.⁹³ From a vessel moving at less than 12 knots, ASDIC's emitted 160 degree wide sound beam to a range of approximately 2,500 yards.⁹⁴ The beam went into the water "at an angle of about sixty degrees to the surface."⁹⁵ ASDIC's deficiency was its inability to detect submarines on the surface and the "blind spot" between the ASDIC beam and attacking vessel's depth charge racks (figure 13). ASDIC could

provide the submarine's distance and bearing, although it was unable to resolve the distance into range and depth.

High-Frequency Direction-Finding (HF/DF or "Huff Duff")

World War II wolf pack operations relied on radio communications to coordinate the pack's actions with U-boat command. The Allies capitalized on this vulnerability using radio direction-finding, initially from shore positions, but later using sets mounted on naval escorts.

Shore-based stations in Iceland, Greenland, and on either side of the Atlantic could detect U-boat radio transmissions and determine an approximate location by triangulating the intercept bearings. As the accuracy from shore locations proved inadequate in directing counterattack assets, devices were modified by November 1942 to fit aboard the convoy's escorts.⁹⁶

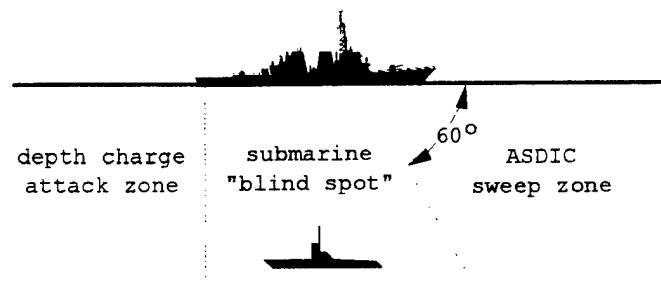


Fig. 13. The Submarine "Blind Spot"

Depth Charges

As torpedoes are to submarines, depth charges are to anti-submarine vessels. A hydrostatic detonator explodes the device at a

predetermined depth, which the charge reaches via gravity, i.e., "falling" through the water at varying rates. Escort vessels were typically fitted with stern launchers to throw the canisters in set patterns, intended to encompass a submarine. Early patterns of five charges were modified upward in mid-1941 to ten or fourteen "with favourable results."⁹⁷

Difficulties with depth charge attacks included the inability to determine accurately the submarine's depth, hence required settings on the explosive charge, and the "blind zone" which provided alert U-boat captains an opportunity to alter course in the narrow window between ASDIC detection and the delay in a depth charge attack. Increasing the depth charge's sink rate narrowed the "blind zone," but only the development of a "forward" depth charge (hedgehog and then squid), coupled to the ASDIC by means of a depth prediction device (the Type 147B ASDIC depth predictor), would eliminate the deficiency.

Hedgehog

An ahead-thrown weapon with mortar projected barrage of 24 contact charges, trainable to about 20 degrees off the bow of the ship.⁹⁸

The "multi-spigot" mortar could throw the projectiles approximately 250 yards ahead of the attacking ship. This forward attack, coupled with the ASDIC, reduced the "blind zone" from 45-90 to 15-20 seconds.⁹⁹ Incorporating a contact fuze eliminated the difficulty in estimating depth of the submarine, but did not produce the same psychological effects on a crew as the "classic" depth charge and, despite its performance, "never superseded the depth charge."¹⁰⁰

Radar

But it was plain to all who were engaged on solving the problem that an efficient radar set would contribute more to the defeat of the surfaced U-boat than any other single measure.¹⁰¹

The Allies began fielding radar to aircraft and surface escorts by March 1940.¹⁰² The system overcame ASDIC's inability to detect submarines on the surface, was operable in any weather, and, when coupled with HF/DF and ASDIC, further reduced the ability of a U-boat to approach a mercantile convoy undetected.

Rayner explained an added benefit of the new device:

No more searching for a convoy in thick weather. Half the worry and strain of a commanding officer's life would be taken away by this wonderful invention.¹⁰³

Not only could the device find surfaced U-boats in foul weather, it allowed escorts the ability to rendezvous easily with a convoy in mid-ocean, maintain station on the formation, even in poor weather, and offered the flexibility to chase U-boats over extended distances with strong probability of joining the convoy once the hunt had ended.

A Final Thought on Weapons

The short discussion offered above does not address all anti-submarine weapons developed throughout the war, nor does it reflect the contribution of aircraft to the anti-submarine effort. While escort carriers eventually provided convoys "floating" air coverage, the U-boat's counterforce in the vicinity of a mercantile convoy, the focus in this study, was more likely the six to eight destroyers, corvettes, and

frigates of an escort group employing the sensors and weapons just described.

Naval Vessels of an Allied Escort Group

In Escort, Rayner describes a mission he received to escort a fast convoy down to the Cape of Good Hope. His comments highlight arguably the most important characteristic of escort vessels:

The speed of the convoy was fifteen knots, the same as our own best speed. It was a nerve-racking job because, if we lost station on the convoy it was impossible to regain it; and we could carry out no anti-U-Boat manoeuvres at all for the safety of our charges. An anti-submarine escort can only be fully effective when the escorting ships have a big excess of speed over that of the convoy.¹⁰⁴

Rayner's achieved his "best speed" of fifteen knots in HMS Verbena, a Flower-class corvette, described as having borne "the main escort burden."¹⁰⁵

In contrast to the corvette, which Rayner highlights was not intended as an ocean-going escort vessel,¹⁰⁶ Geoffrey Jones, in Defeat of the Wolf Packs, describes the Captain-class frigate as a "purpose-built U-boat attacker."¹⁰⁷ These vessels were of prefabricated construction and built both in England and the United States. Jane's Fighting Ships: 1943-44, reports the Captain-class frigate's speed of twenty knots at 5,500 horsepower.¹⁰⁸

Destroyers formed the nucleus of Britain's escort groups, with John Winton's Convoy noting that many of them were Hunt-class.¹⁰⁹ Although approximately four hundred tons smaller than the 1,300 ton Flower-class frigates, they had larger power plants, capable of 27.5 knot speeds at 19,000 shaft horsepower.¹¹⁰

To complete Rayner's thought regarding the importance of speed differential over an escorted convoy, a comparison of these three naval escort vessels, slow and fast convoys, and the Type VII U-boat is presented below in table 6. Fast convoys reflected in table 6 are mercantile convoys, where the "fast convoys" Rayner referred to above were troop ships. These numbers highlight further the importance of an escort maintaining station on the convoy and the criticality of keeping U-boats submerged.

TABLE 6

SPEED COMPARISON OF ESCORT VESSELS, CONVOYS,
AND THE TYPE VIIC U-BOAT

	Speed [knots]
Flower-class Corvette.....	15
Captain-class Frigate.....	20
Hunt-class Destroyer.....	27.5
Fast Convoys.....	9-10
Slow Convoys.....	7.5
Type VIIC/C41 U-Boat (surfaced) ..	17-17.7
Type VIIC/C41 U-Boat (submerged) ..	7.6

Source: Francis E. McMurtrie, ed., Jane's Fighting Ships: 1943-4 (New York: The Macmillan Company, 1945), 56, 74, and 76; Stephen Roskill, The War at Sea, 1939-1945, 3 vols. (London: H. M. Stationery Office, 1954), 345; and David Westwood, The Type VII U-Boat (Annapolis, Maryland: Naval Institute Press, 1984), 12.

Escort Group Command and Control

Of the command and control issues related to the protection of mercantile shipping, the most interesting is the relationship of the escort group commander to the commodore of the convoy.

The escort commander was responsible not only for the conduct of the escort ships, but for the entire convoy. On his

shoulders fell the job of directing changes in course and issuing whatever other instructions were necessary for the safety of all the ships. The convoy commodore, from his flagship among the merchant ships, was responsible for maintaining the internal discipline of the convoy proper, in terms of navigation and holding to position.¹¹¹

Many convoy commodores were retired naval officers, some admirals, who volunteered their services at war's outbreak. Now junior in grade to all captains, Royal Navy, they were returned to active duty as a Commodore, Royal Naval Reserve. Interestingly, many escort group commanders, F. J. Walker, perhaps the most famous, were only commanders and a few, D. A. Rayner (Escort) included, were Royal Navy Volunteer Reserve. Despite the awkward rank structure, Winton's Convoy records that "normally it all worked very well."¹¹²

Escort Operations in the Pacific Theater

For the masters of a maritime nation launching a seagoing war, Japan's military leaders were strangely remiss in the matter of protection for their merchant marine. Their negligence in this regard seems as stupid as it was costly.¹¹³

In United States Submarine Operations in World War II, Theodore Roscoe spends roughly two pages highlighting failure after failure in identifying and responding to the threat to Japan's mercantile shipping. Some convoy operations were begun in 1942, and more formal convoy instructions were issued in early 1944, but "throughout the Pacific War the behavior of the Japanese escort was completely unpredictable."¹¹⁴

Escort Organizations

On November 15, 1943, the Japanese organized the Grand Escort Fleet, composed of two surface escort squadrons (between 25 and 30 total vessels) and the 901st Air Squadron.¹¹⁵ As Japanese convoys in the

Pacific were significantly smaller than their Atlantic counterparts, a single destroyer was the typical escort "group."¹¹⁶ Japanese escort organizations never received the formal training, adequate vessel densities, or organizational stability found in Allied organizations in the Atlantic after 1943.

Kaibokan

These vessels, originally designed as coastal defense vessels, formed the "backbone" of Japan's escort force. Hardly a class like the Flower, Captain, or Hunt, kaibokan describes a "type" of vessel, ultimately found most suitable to perform convoy security.

Typical speeds varied from sixteen to twenty knots and they were described by Roscoe as "floating munitions dumps," sometimes carrying up to three hundred depth charges. Japanese sonar and radar aboard these vessels were less effective than British systems.¹¹⁷

Counterforce Conclusions

Discussions of German and American wolf packs led to the realization that organizations, tasks, and purposes, with the exception of scale, were quite similar between the two theaters. The differences, where they existed, were a function of the "terrain" and enemy. Both pack forces achieved great success, yet in 1945, only American submarines emerged victorious. Theodore Roscoe concludes:

But the [Japanese] surface escort fleet, like the convoy system, was improvised and makeshift--a last-minute effort to rescue a foundering merchant service. When the Grand Escort Fleet was finally assembled, scores of freighters, tankers, passenger ships and transports were resting their torpedoed bottoms on the ocean's floor. The convoy escorts arrived too late. Deep-sea divers and salvage vessels were in order.¹¹⁸

These circumstances make cogent analysis of an overall World War II wolf pack experience impossible. Discussion of the Japanese target will reveal smaller, less organized formations of merchant vessels and the *counteraction*, although sporadically successful, was, as Roscoe points out, "completely unpredictable." The balance of this thesis will therefore focus on the Atlantic experience, with a brief discussion of American wolf pack action presented only for completeness.

The Target = Mercantile Convoys

"The convoy was at once our charge and our bait."
- D. A. Rayner in *Escort*

Between September 1939 and May 1945, approximately 75,000 Allied merchants sailed in British-controlled Atlantic convoys, losing only 574 ships (0.8 percent). In comparison, independents sailing Halifax and Freetown in early 1942 experienced a 14.6 percent attrition rate.¹¹⁹ Together, these data highlight the criticality of the convoy system. Operational researchers spent untold hours analyzing statistics of U-boat sinkings, comparing convoy sizes, speeds, and escort strength to the operation's ultimate success.¹²⁰

Convoy Speed

At the most basic level, the faster a convoy travels, the harder for U-boats to intercept, reach suitable firing positions, and accomplish multiple attacks. The station keeping, zig-zag defensive maneuvers, and detouring around suspected U-boat locations slows a group of ships. Therefore, in order to offer protection without unnecessarily burdening faster vessels, the Admiralty established fifteen knots as an

upper limit on ships required to participate in convoy operations.¹²¹ A system of fast (nine to ten knots) and slow convoys (7.5 to eight knots) was established.¹²² Data compiled on fast and slow convoys sailing between August 1942 and January 1943 is shown in table 7. Westbound convoys used more southerly routes than those formations bound for Europe from North America.

TABLE 7
CONVOY LOSSES FROM AUGUST 1942 THROUGH JANUARY 1943

	Number of Convoys	Percent Sighted	Percent Attacked	Sinkings per Convoy
Northerly				
Slow				
(7 knots).....	36	68	43	1.9
Northerly				
Fast				
(9.5 knots)....	44	68	41	1.3
Southerly				
Slow				
(7 knots).....	8	88	88	2.9
Southerly				
Fast				
(9.5 knots)...	7	86	86	3.7

Source: Charles M. Sternhell and Alan M. Thorndike, Antisubmarine Warfare in World War II (Washington: Operations Evaluation Group, Office of the Chief of Naval Operations, 1946), 105.

Convoy Size and Formation

"A typical average size of convoy during the Battle of the Atlantic was about 30 ships,"¹²³ although organizations of up to sixty ships were prevalent earlier in the war and the largest westbound convoy had 187 ships.¹²⁴ Transoceanic convoys were typically larger than those traveling along shorter routes in the European theater.

Departing the harbor, vessels would typically remain in two columns, sometimes spread out to over twenty miles.¹²⁵ After clearing the coast, ships would transition to an ocean-going formation of four to five ships per column, with as many columns as necessary to form the contingent.¹²⁶ The result was a rectangle, sailing on a broad front, but a formation which offered the smallest flank to U-boat attack (figure 14).

It is appropriate here to discuss the orientation of an escort group to this typical convoy formation, but these spatial relationships will take on more meaning after discussion of a wolf pack's actions, specifically favored firing positions.

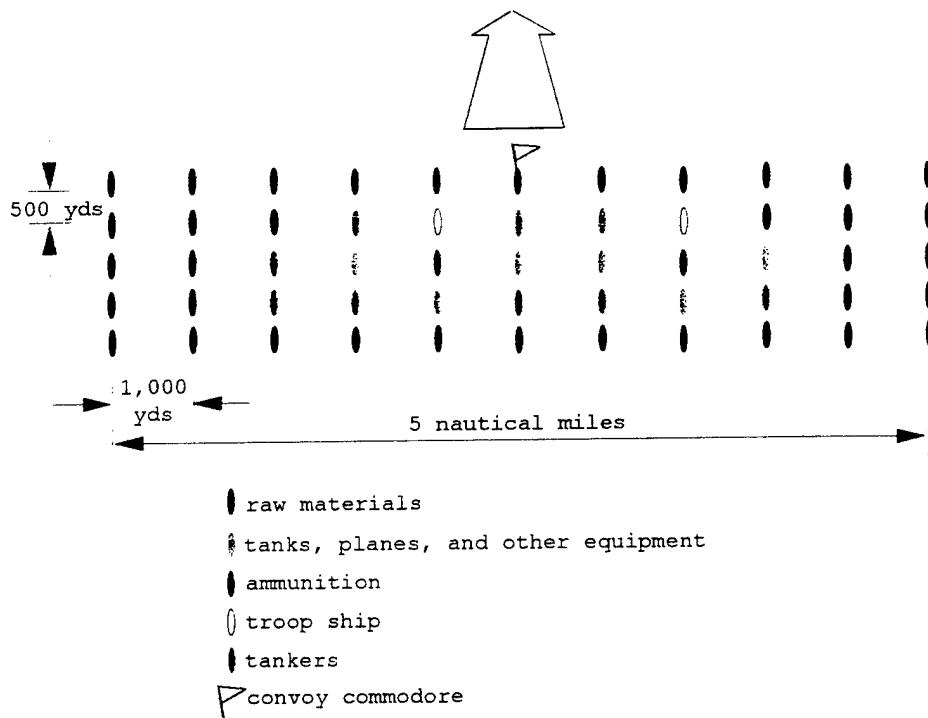


Fig. 14. Typical 1942 Convoy. Source: Barrie Pitt, World War II - The Battle of the Atlantic (Alexandria, Virginia: Time-Life Books, 1977), 126-27.

Wolf Pack Maneuver: The Action

The object of the common attack is to produce contact between a number of submarines and an adversary who has been located by a submarine or another reconnaissance unit [aircraft], to maintain that contact, and to destroy the enemy.¹²⁷

Step 1. Waiting/Action Station Occupation

The "waiting station" is a preliminary position before taking up action stations. It is used when precise details of a given target are not available, and when the Submarine Command wishes to reserve its decision as regards the attack, after receiving reports about important targets.¹²⁸

The concept of waiting stations was discussed earlier in the context of patrol lines when outlining wolf pack organizations. The U-Boat Commander's Handbook suggests these positions provided flexibility to maneuver toward a number of targets, allowing Submarine Command to refine intelligence before designating the "main target." Submarines could not vacate these locations unless they were forced to by anti-submarine forces, contacted the "main target," located a target of equal value as the "main target," or were ordered to.¹²⁹

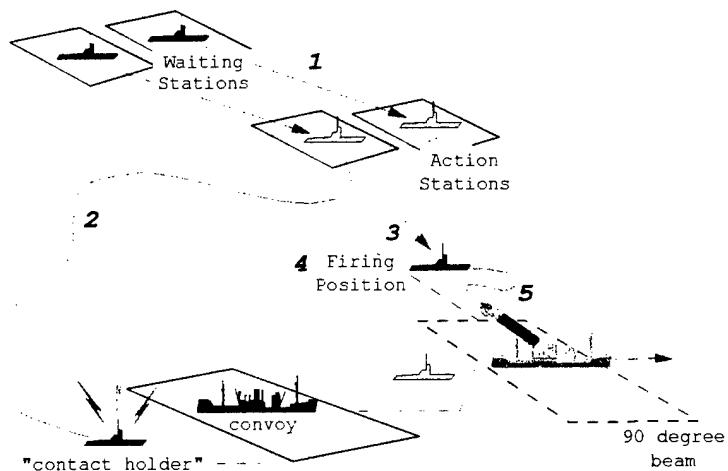


Fig. 15. Wolf Pack Engagement Sequence

Action stations were occupied when Submarine Command identified a "particular" enemy unit as the "main target," specified in the boat's orders. These positions were occupied similarly to waiting stations, the U-boat remaining there until the target was contacted.¹³⁰

Step 2. Establish Contact with the Convoy

The success, or otherwise, of the attacks of all the other submarines operating against the convoy depends on the skill of the first submarine, whose duty it is to keep the contact with the convoy.¹³¹

The first two submarines to gain contact with a convoy were designated as the "contact holders," responsible to transmit hourly position reports. These reports contained the position, course, and speed of the enemy. Additionally, the "contact holder" would send out D/F and wireless signals on the half hour to guide other attacking boats to the convoy.¹³²

Step 3. Departing Action Stations and Movement to Firing Positions

On receipt of the first report of contact with an important objective, all submarines within range begin to operate against that objective. An order to attack is not needed.

The commanders must not allow themselves to be deterred from attacking because of initial considerations of distance. It is known that submarines stationed at a distance of more than 400 sm have carried out successful attack against the objective.¹³³

The objective was to arrive at a suitable firing position just ahead of the enemy's beam (sixty to ninety degrees off the target's axis of movement). This position supplemented the submarine's small speed advantage and reduced ballistic errors from misjudging position. The

"overhauling maneuver,"¹³⁴ accomplished from action stations to firing position, was a difficult balance of speed and "invisibility."

Although the "contact holder's" radio transmission likely alerted Allied vessels to the presence of U-boats, commanders were guided to remain unseen. Daylight procedures required the boat to submerge as the very tops of enemy mastheads came in sight, "visible in clear air at best at 10,000 to 12,000 metres."¹³⁵ Recognizing the speed decrement while submerged, boats were further instructed that "the place of the submarine is on the surface"¹³⁶ as soon as visibility conditions allowed. The "final attack run," characterized by frequent periscope observation (if conducted underwater) should begin approximately four to five thousand meters from the target.

Step 4. Approach and Engagement

When the submarine has reached the necessary position forward of the enemy's beam . . . it must move toward the enemy on the surface and underwater, always in the endeavor to get in a shot (discharge a torpedo) as soon as possible, before the position changes, i.e., before, for example, the enemy changes course, in such a way as to foil the attack.¹³⁷

Day and night attacks were specified at ranges between three hundred (safety distance from the submarine) and one thousand meters. At longer ranges (greater than one thousand meters), desirable firing positions were further ahead from the beam position, approximately sixty degrees off the target course. The Handbook specified "fan patterns" of two, three, or four torpedoes at these longer ranges.

In addition to range, attacking with the sun behind and from the weather side (windward) in eight to eighteen mile per hour winds, put sun and sea spray in the target lookouts' faces, while masking the

periscope and enhancing its target area visibility. Night attacks emphasized positioning the submarine in the darkest quarter of the horizon, taking precaution to prevent silhouetting the U-boat in the moon.¹³⁸

Step 5. Maintaining Contact

If several boats are being used in the attack, none of them must break off the pursuit merely because it has used up its torpedoes. It must follow the convoy, seeking to contact it, and maintain the contact. As there is no longer a target, it should take up the most favorable position as a "contact holder" (for example, sun, convoy and submarine in time), and continue to send messages. The boat will be ordered back as soon as possible.¹³⁹

American Pack Action

In United States Submarine Operations in World War II, Theodore Roscoe describes American wolf packs. Like their German counterparts, the initial submarine maintained contact and transmitted target information to her pack mates. Flanks were also the preferred firing position in the Pacific. The principle difference in American and German pack tactics was the "end-around" maneuver.

The first submarine to engage a Japanese convoy would typically drop to the rear of the convoy, maintain contact with the target, transmit course changes to other members of the pack, and finish off stragglers. Remaining boats, typically two, would accomplish multiple engagements, withdrawing as necessary, and completing the Pacific-equivalent of the "overhauling maneuver," the "end-around," to move back to favorable firing positions.¹⁴⁰

The "end-around" (figure 16) is described as "an all-night, surface pursuit, culminating in an attack made from a position ahead of the convoy."¹⁴¹ Sailing on the surface at night provided American submarines the same advantages as night surface attacks in the Atlantic offered Doenitz. The Gato-class submarine's nearly four knot surface speed advantage over the Type VII, reduced anti-submarine threat in the Pacific, and, eventually, shipboard radar, combined to allow this maneuver's success.

Its significance with respect to German wolf packs is in the maneuver-oriented flavor it provided, a stark contrast to the attrition-based anti-commerce warfare waged by Doenitz's submarines. The Handbook highlighted that positional advantage in the Atlantic, once achieved, was difficult to achieve again. Pacific theater wolf packs appear not to have suffered these same limitations.

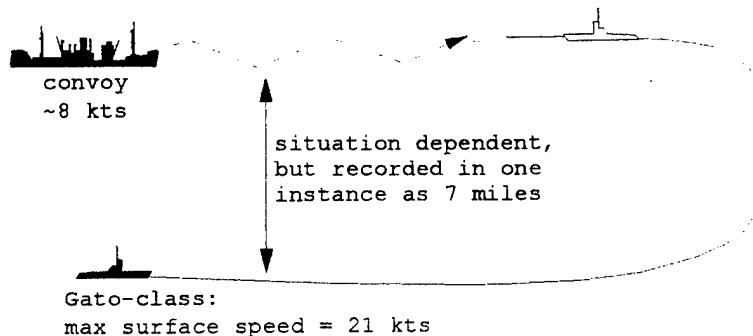


Fig. 16. The "End-Around"¹⁴²

Defeating the Wolf Pack: Counteraction

Before the war we had beaten our chests with pride in our new asdic, and had confidently announced to all the services that we had the answer to the U-Boat peril. And so we had-so long as

the U-Boat stayed submerged. But in the darkness of the winter nights he nearly always attacked on the surface, and until we could detect his presence with radar we fought him with our eyes, with seamanship, and with bluff.¹⁴³

This chapter has previously discussed weapons and sensor systems employed by escort forces to detect and attack submarines. While important, these technical devices are only half the story, and a brief discussion of tactical considerations is required to finish describing the activity around a convoy in the Battle of the Atlantic.

Active Defense

Countering the Tactic

Three conditions are required to accomplish a successful wolf pack engagement: (1) the "contact holder" must gain and maintain contact, (2) U-boats within striking distance must close to acceptable firing positions before the convoy moves out of range, and (3) the boats must deliver multiple attacks. Each of these is made more difficult by increasing escort group size, as exhibited by three escort groups, the 40th, 7th, and 5th, ultimately joining to protect the combined SL 139/MKS 30 south of Sierra Leone (sixty-six merchant ships protected by twenty-eight escort vessels).¹⁴⁴ The result was one vessel sunk and one damaged in return for three U-boats sunk and two long-range aircraft shot down.

Defeat the Contact Holder

Until the introduction of shipboard radar, the Germans clearly favored night surface attacks as a counteraction to an escort's ASDIC.

In Escort, Rayner notes:

Salopian, had I ever heard of the enemy starting an attack in the afternoon. . . . It almost seemed as though the German captains played to a 'convention' as far as those times were concerned.¹⁴⁵

To counter the U-boat's propensity for night attacks, towards dusk we would send out a destroyer for some twenty miles to put down the shadowers. When they had been forced under, the course of the convoy would be altered forty-five degrees in the down-wind direction. At midnight the course would be altered back to the original one, but the convoy would then be twelve miles further down-wind than the enemy would expect, and in the dark his chances of making contact would be much slimmer.¹⁴⁶

Deny Favorable Firing Positions

A "typical" 1942 escort group orientation is reflected in figure 17. Note the flank destroyers forward and corvettes to the rear in positions the U-Boat Commander's Handbook clearly outlines as doctrinal submarine firing positions. The flank corvettes, coincidentally, patrol in the area Peter Cremer described in U-Boat Commander as the best visual range to keep mastheads in sight.

Prevent Multiple Attacks

While in the early stages of the Atlantic battle a handful of escorts could make only brief counter-attacks against attacking U-boats and then hurry back to the convoy, with [Johnnie] Walker, the situation had reversed. Several escorts advanced in a coordinated attack against the U-boat and did not let go of it. They followed its evasive manoeuvres until finally, like hunters with their quarry, they had encircled it and brought it down.¹⁴⁷

The Tactical School, initiated in 1942, provided a "good idea clearing house" for techniques like Walker's "Operation Buttercup"¹⁴⁸ attack and helped overcome the war's earlier difficulties in *ad hoc* escort forces and the lack of standardized procedures among organized escort groups.

Passive Defense

The most logical passive defense against the wolf pack attack is to avoid it completely. Allied use of HF/DF from shore and shipboard systems frequently detected radio transmissions between Submarine Command and deployed U-boats and allowed multiple stations to determine an approximate position of the waiting submarines. Rerouting the convoy exacerbated the already difficult task of closing the distance from action stations.

Perhaps the most common technique was the periodic zig-zag maneuver, accomplished to upset a boat's maneuver into suitable firing positions. Earlier, Rayner highlighted its use in conjunction with a sweep of probable "contact holder" locations, demonstrating its effectiveness in protracting an already difficult approach for the submarine.

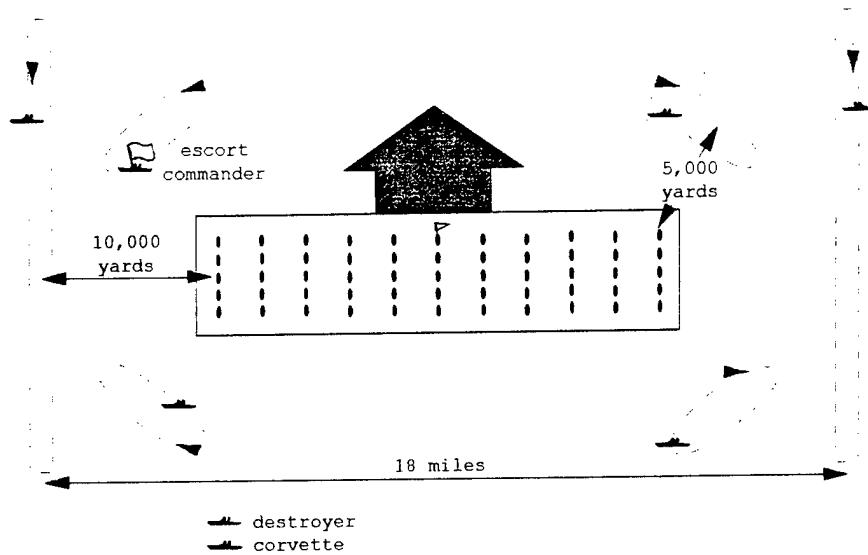


Fig. 17. Typical 1942 Convoy with Supporting Escort Group. Source: Barrie Pitt, World War II - The Battle of the Atlantic (Alexandria, Virginia: Time-Life Books, 1977), 126-27.

Conclusions

This lengthy discussion attempted to describe the wolf pack experience throughout World War II in terms of the battlefield mechanics defined in chapter 1.

Forces, to include counterforces, in both the Atlantic and Pacific theater, were described to the conclusion that Japan never effectively organized a convoy or significant escort threat in response to America's submarines. The Pacific's poorly-organized target and escort forces (therefore poorly defined counteraction) do not suggest that comparison using America's pack experiences is inappropriate. Theodore Roscoe ably describes Pacific wolf pack tactics, and so long as the comparison concentrates on *how* the force fights, and not *how well* the force fought, the discussion is relevant.

It is crucial, however, to analyze Atlantic convoys, their escorts, and both passive and active counteraction taken by each to completely assess the nature of a maritime target, and its environment, in comparison to a massed armored or mechanized formation.

The format used here is repeated in chapter 5, with each intended to stand alone. Conclusions regarding the comparison of these two forces is reserved to chapter 6, although some of the descriptions and figures (figure 15) were drafted with an eye to highlighting similarities and differences.

In any event, the author discovered no reference which compared the Atlantic and Pacific wolf pack experience directly. Regardless of the conclusions with respect to packs and attack helicopters, this chapter serves that useful purpose.

CHAPTER 5

MODERN ATTACK HELICOPTER BATTALION OPERATIONS

I believe that [Army] aviation is the dominant combat arm of the future.

- General G. K. Otis, U.S. Army, 1983

It was the Apache that was the single biggest maneuver factor on the battlefield [in Desert Storm].

- MG Barry R. McCaffrey, CG, 24th ID(M), 1992

Introduction

During Desert Shield/Storm, 288 Apaches (AH-64),¹ from fifteen different attack helicopter units, flew over eighteen thousand hours² and launched approximately one thousand Hellfire missiles, which Apache crewmembers reported as having killed "278 tanks, over 500 light and armored vehicles, over 100 pieces of artillery, and a variety of other targets."³

Army Aviation's growth has followed an often rocky road, even before the Vietnam reorganization of the 11th Air Assault Division and 2nd Infantry Division into the 1st Cavalry Division (Airmobile) in 1965.⁴ As noted earlier, Matthew Allen describes the attack helicopter's maturation process in Military Helicopter Doctrines of the Major Power, 1945-1992 as largely an issue of acceptance by the Army's other combat arms rather than consideration of its relevance to the modern battlefield. Statements from prominent ground commanders, like those above, seem to suggest attack helicopter organizations, one of the principle forces in this study, may have finally "arrived" in both

capability and acceptance. Some Gulf War after-action reports suggest that, "History will record DESERT STORM as the first mechanized conflict dominated by the use of massed attack helicopters."⁵

This chapter describes the attack helicopter's environment. Coupled with chapter 4's description of wolf packs, the two ultimately provide the basis of comparison necessary to draw conclusions regarding parallels in the way these two forces fight.

Presentation of the force will focus on the attack helicopter battalion (ATKHB), but it includes a snapshot of Soviet-style air defense systems (*counterforce*) and the organizations that are expected in the vicinity of a massed armored or mechanized target. That target is discussed only in enough detail to lay out spatially its major elements and concludes with an air defense overlay that describes the picture an attack helicopter may see upon arrival in a battle position for an engagement. The study explores the ATKHB's action, from arrival in a holding area, through battle handover to another attack helicopter or ground maneuver force. A brief discussion of *counteractions*, by both the target and air defense organizations, used to limit an ATKHB's intended effects, completes discussion of the battlefield mechanics.

The Helicopter Force

Attack Helicopter Battalions

Doctrine describes the attack helicopter battalion (ATKHB) as a maneuver unit, fought at the battalion-level, in coordination with other members of a combined-arms or joint force.⁶ Although the author's experience suggests subordinate elements (i.e., attack helicopter

companies) are sometimes employed away from their parent headquarters, helicopter fuel endurance restricts the staying power offered by the multiple attack companies of a battalion and required in a target rich environment. Additionally, the battalion is the first echelon of command where a staff exists to plan, coordinate, and supervise the execution of combat operations.

Organizational Structure

"Attack helicopter battalions are assigned to divisional aviation brigades, corps attack helicopter regiments (in corps aviation brigades), and some EAC [echelons above corps] aviation brigades."⁷ This means that one or more ATKHBs are normally present anywhere an Army division is employed. They are organized with a headquarters company (HHC), an aviation unit maintenance (AVUM) company, and three attack helicopter companies (figure 18). In some cases, as recently as Desert Storm, attack helicopter companies are further divided into two platoons, often designated as "heavy" (more AH-64s) and "light" sections (less AH-64s).

In Desert Shield/Storm, ATKHBs were organized with both attack and observation (OH-58 series) helicopters. Each attack helicopter company (ATKHC) had four OH-58s and six AH-64s. The battalion headquarters company was assigned four aircraft, one OH-58 and three UH-60s (utility helicopters), to fulfill command and control and logistics support responsibilities for the "fighting" companies.

Fighting conditions in Desert Storm required modifications to the battalion configuration presented above. Older OH-58C aircraft

possessed neither the night fighting optics nor advanced navigation systems required in the Gulf War.⁸ This resulted in attachment of the

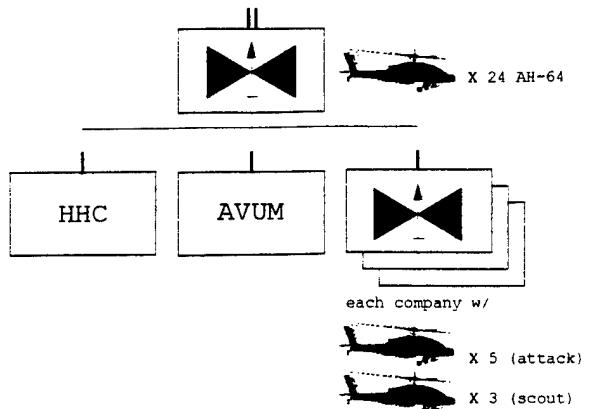


Fig. 18. Basic organizational structure of an ATKHB. Source: US Army, FM 1-112, Tactics, Techniques, and Procedures for the Attack Helicopter Battalion (Washington, DC: Department of the Army, 1991), 1-4 and Kimo Bacon, "Aviation Restructuring Initiative: Modernizing for the Future," (Combat Developments Briefing Slides, US Army Aviation Center, 1995), 17.

more advanced OH-58D aircraft to ATKHBs; engagements conducted exclusively by AH-64s, even in battalions or task forces with more than one type of helicopter; and relegation of the OH-58Cs to air support, artillery, communications relay, and security duties.⁹ Figure 19, an example of these considerations, presents Task Force 3-1 (1st Armored Division) ATKHB's organization for their February 26, 1991 fight against the Medinah and Adnan Divisions of the Iraqi Republican Guards.

The AH-64 Apache (figure 20)

The Apache Operator's Manual defines "the AH-64A helicopter [as] a twin engine, tandem seat, aerial weapons platform."¹⁰

Anticipated high-intensity conflict against Soviet and Warsaw Pact forces drove the Apache's design to: "(1) detect and engage targets from long ranges, (2) fly and fight at night and in adverse weather, and (3) evade enemy air defenses and withstand hits from munitions up to 23-millimeters in size."¹¹ A brief description of the Apache will address each of these intended capabilities.

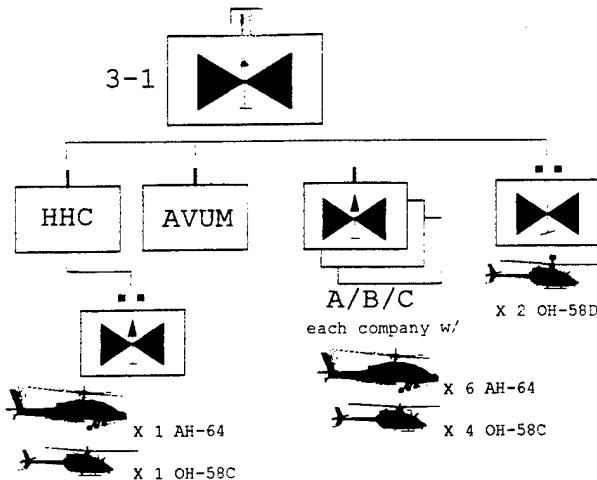


Fig. 19. Task organization of 3-1 ATKHB for destruction of Republican Guards Divisions. Source: US Army. "Army Aviation in Desert Shield/Storm," (Group Scales Papers (SSG A-022), SG Historian Material, US Army Aviation Center, 1992), 109.

Detecting and Engaging Targets at Long Ranges:
Target Acquisition and Designation Sight (TADS)
and Hellfire Missile Systems

The TADS acquires targets using a direct view optical (DVO) telescope, day television (DTV), and forward looking infrared (FLIR) sensor system, either singly or in combination.¹² Once acquired, tracking is "accomplished manually; automatically, using the image auto-tracker (IAT); or by using the laser spot tracker (LT)."¹³ This last

device, the LT, provides the capability to acquire laser designations from a remote site (i.e., another helicopter). The AH-64 accomplishes target designation by arming the laser spot tracker and firing the laser using the laser range-finder/designator (LRF/D).¹⁴ The IAT, through use of an offset, is able to track two targets automatically and simultaneously.¹⁵ These capabilities far exceed those of the Apache's predecessor, the AH-1 Cobra, whose acquisition systems were limited primarily to a DVO mechanism (the Telescopic Sight Unit (TSU)).

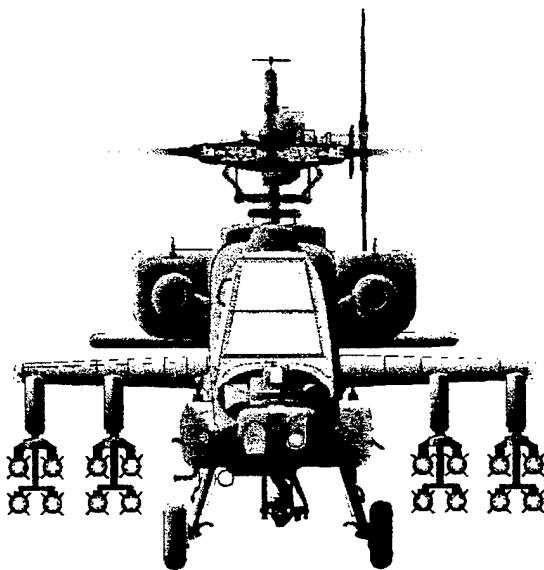


Fig. 20. The AH-64 Apache

The Hellfire anti-tank missile is the "primary armament on the helicopter for the destruction of tanks and other hard material targets."¹⁶ The Apache can carry up to sixteen of these missiles on four launchers. Nominal engagement ranges are from six to eight

kilometers (3.7 to five miles) with Desert Storm Hellfire engagements varying from four to six kilometers (3-1 ATKHB against Medinah and Adnan Divisions on February 26, 1991)¹⁷ to 2.5 to three kilometers (2-229 ATKHB at the causeway).¹⁸ Two Government Accounting Office reports indicating Desert Storm success with the missile disagree, but place Hellfire accuracy on the order of sixty-five to seventy-six percent.¹⁹

The Army defines the deep battle as those activities which are "directed against enemy forces and functions beyond the close battle. They may be separated from the close battle in time or space or both."²⁰ "Long range" considerations might arguably include the Apache's ability to fight deep maneuver engagements. Developing tactics, techniques, and procedures (TTP) for the AH-64, including an extended range fuel system, offers a combat radius approaching 350 kilometers (217 miles).²¹ The Battle of the Causeway (Desert Storm) put attack helicopter forces seventy-five kilometers beyond any friendly force in order to attack Iraqi forces fleeing northward.²²

Fly and Fight at Night and in Adverse Weather:
Pilot Night Vision Sensor (PNVS)

According to the AH-64 Operator's Manual: "The pilot night vision sensor (PNVS) is used by the pilot for externally aided vision at night or during adverse weather."²³ It is an integral component, through the commonly shared FLIR, to the aircraft's acquisition function and was combat proven during Desert Storm. LTC Bill Bryan, Commander of the 2-229th ATKHB during the Gulf War, highlighted the problems of burning oil fires and destroyed vehicles as significant enough to cause

Apaches to switch from DTV to FLIR during his engagement at the Al Hammar causeway:

This was purely a helicopter fight. In my mind, first of all, the Air Force had nothing they could fly and fight in 300 meter visibility and there is no other piece of equipment that can fly at that distance, that fast, and certainly it would have taken an armor division a day to get there. So, this was clearly a classic, armed-helicopter mission especially with the FLIR system.²⁴

LTC Bryan's comments are insightful, yet misleading. The engagement he describes was classic only in the sense that Army aviation proponents had envisioned this type of battle since determining early design criteria for the Apache (limited visibility engagements). His participation in the Battle of the Causeway became realization of capabilities long imagined; made possible by the AH-64's systems.

Evading Enemy Air Defenses

It is weapon systems' ranges that ultimately provide the Apache its greatest ability to evade enemy air defense systems. The Hellfire missile's range provides the Apache some weapons standoff from most air defense systems traditionally organized to protect Soviet-style regimental and smaller maneuver formations. This standoff, when combined with twin engines, crew compartment armor, and a suite of electronic countermeasures, has "hardened" the AH-64 against short-range tactical air defenses.

Communications

"The primary means of tactical communications within the ATKHB is the FM-secure [frequency modulated-encrypted] net."²⁵ Within the ATKHCS, ultra-high frequency (UHF) and very-high frequency (VHF) radios

control subordinate helicopter elements and, if necessary, communicate with supporting Air Force assets. An example radio network for the ATKHB is outlined in figure 21 below.

Extended lines of communication experienced during the Gulf War repeatedly demonstrated the inability to maintain radio contact with aircraft operating beyond the forward line of troops (FLOT). Units tried endless "work-arounds": using OH-58C aircraft as communications relay platforms, organizing "jump" tactical operations centers aboard command and control equipped UH-60s, and collocating operations officers with higher headquarters' operations centers.²⁶ The Desert Storm

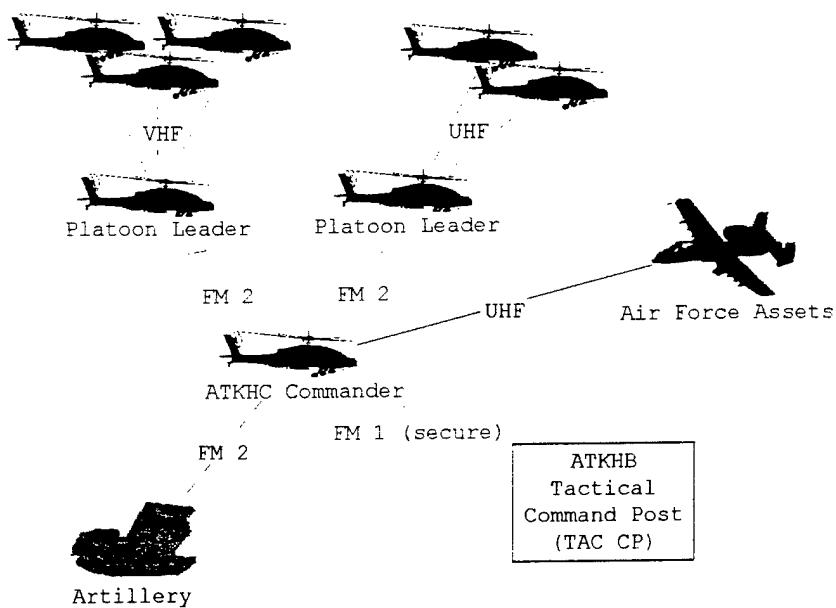


Fig 21. Example ATKHB Radio Networks. Depending on the employment option, an additional link is required to coordinate attacks with supported ground maneuver headquarters, as appropriate. Source: US Army, FM 1-112, Tactics, Techniques, and Procedures for the Attack Helicopter Battalion (Washington, DC: Department of the Army, 1991), 2-14.

experience suggests that centralized command and control is extremely difficult, given the ranges at which these helicopter forces are operating from their controlling headquarters, and "put a premium on commanders leading from the front."²⁷

Command and Control (C2)

A key issue highlighted by numerous after action comments was the question of the battalion commander's location during an engagement. Doctrine suggests the commander and operations officer are often airborne in the vicinity of the fight, typically in separate aircraft to assure continuous control.²⁸ The lack of advanced navigation and night vision systems on the UH-60 and OH-58, typically devoted to these C2 functions, often forced commanders into the front seat of "spare" AH-64s.²⁹ This method is non-doctrinal, but was possible "due to the fact that corps had issued extra maintenance floats [spare aircraft] to individual battalions."³⁰

Air Defense - The Counterforce

Experience suggests that, when launched against massed armored or mechanized targets, ATKHBs target regimental-size "chunks" and ultimately engage battalion-size organizations within a given engagement area. These regimental maneuver formations, under Soviet-style organizations, are supported by an air defense battery, possessing up to seventy percent (109 of 156 weapons in motorized rifle units) of a division's surface-to-air missile (SAM) and gun air defense systems.³¹ Apache designers likely considered the weaponry of this battery as their most probable threat, given the previously stated AH-64 design goal of

withstanding "hits from munitions up to 23-millimeters in size." The "23-millimeter" reference probably alludes to the platoon of ZSU-23-4s, a self-propelled, four-barrel, 23-millimeter air defense gun, in the air defense battery of a regiment. Arguably, this battery was the focus of AH-64 designers and will serve that role for this study.

Regimental Air Defense Battery Organization

The former-Soviet motorized rifle regiments' air defense battery includes a headquarters, a ZSU-23-4 platoon, an SA-9/13 platoon, and support and service elements (figure 22). The regiment's chief of air defense is responsible for "planning and directing air defense activities within the regiment" and to advise "the commander on allocation and deployment of the regiment's air defense assets."³² The battery's weapon systems are spread throughout the regiment to support battalion-level formations and critical command and control nodes.

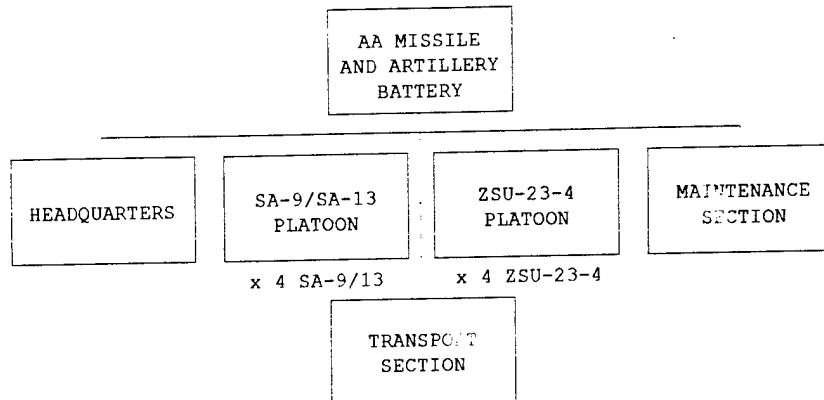


Fig. 22. Antiaircraft Missile and Artillery Battery Organization.
Source: US Army, FM 100-2-3, The Soviet Army: Troops, Organization and Equipment (Washington, DC: Department of the Army, 1984), 4-15.

Weapon Systems

ZSU-23-4 Shilka

"The ZSU-23-4 is a fully integrated, self-propelled antiaircraft system with four liquid-cooled 23-mm automatic cannons mounted on the front of a large, flat, armored turret."³³ Four of these weapons are organic to the former-Soviet motorized rifle or tank regiment's air defense battery.

They provide point air defense to forward motorized or tank battalions in the attack and are normally employed in pairs for mutual support. Given the gun's 2,500 meter maximum effective range (optical engagement), separation between the systems is a doctrinal 1,500 meters (in a march formation) to ensure overlapping fires.³⁴ The four-barrel gun is integrated with a GUN DISH acquisition and tracking radar. The susceptibility of the radar to electronic countermeasures, high ammunition expenditure, and thin skin are significant limitations to the SHILKA.

SA-13 Gopher

The SA-13 began fielding in 1980 as a replacement for the four SA-9 missile systems of the regimental air defense battery.³⁵ The SA-13's tracked chassis provided significant mobility improvement over the wheeled SA-9. However, like its SA-9 predecessor, thin skin makes it vulnerable to suppressive fires. A DOG EAR radar system (mounted on a separate chassis) supports the missile platoon with early warning/acquisition to ranges of forty kilometers, with SA-13 missile engagement ranges from one-half to eight kilometers.³⁶

SA-7 Grail/SA-14 Gremlin

The SA-7/14 supplements the larger ZSU-23-4 and SA-13 air defense coverage over the regiment. Both are "man-portable, shoulder-fired, low-altitude, surface-to-air missile systems"³⁷ and were the only system credited with shooting down an AH-64 during the Gulf War (believed an SA-14).³⁸ Characteristics of the SA-7's two versions, and follow-on SA-14 missile, are tabulated below (table 8).

The Attack Helicopter Battalion's Target

Target Conditions

Previous chapters have highlighted the attack helicopter battalion's doctrinal mission of attacking massed enemy mechanized and armored formations. Doctrine suggests the effectiveness of these attacks is directly related to the enemy's posture when engaged, highlighting that "the ATKHB is most effective against massed, moving

TABLE 8

CHARACTERISTICS OF SOVIET SHOULDER-FIRED SURFACE-TO-AIR MISSILES

	SA-7a	SA-7b	SA-14
Operational Range [km].....	3.6	5.5	5-7
Minimum Range [km].....	0.5	0.5	
Speed [m/s].....	470	580	
Systems within the Regiment*. .	12/30	12/30	12/30

*tank/motorized rifle regiment. Source: US Army, FM 100-2-3, The Soviet Army: Troops, Organization and Equipment (Washington, DC: Department of the Army, 1984), 5-95.

[emphasis added] targets and least effective against enemy forces that are in prepared, well-camouflaged positions."³⁹

Soviet-style units move using march, prebattle, and attack formations, in order, as forces close with an enemy. Attack formations are normally assumed "within about 1000 meters of enemy positions."⁴⁰ Prebattle formations attempt to minimize troop vulnerability to conventional artillery and air strikes, while also maintaining rapid movement rates. March formations are used doctrinally further away from the FLOT and, although they consider security by dispersing the force laterally and in-depth, typically consist of vehicles moving in more densely-packed elements.⁴¹ In combination, characteristics of mass and movement, important to the effectiveness of an ATKHB mission, are most prevalent in Soviet-style march formations. Discussion of the target mechanic will therefore focus on motorized rifle and tank battalion march formations.

Motorized Rifle and Tank Battalions in the March

Motorized rifle and tank units may move in the march formation as an advanced guard of a larger force, within the main body of a parent formation, or, as in the case of regimental or division reserves, separately. Like American units, the battalions are task organized with air defense, artillery, and engineer assets. Although a number of factors influence the target's appearance on the battlefield, comparison with the wolf pack's convoy requires enumeration of vehicle density, doctrinal depths and widths, march rates, and a discussion of air defense positioning to support the march formation.

Viewing a BMP-equipped motorized rifle regiment from overhead would reveal rifle and tank battalions with the vehicle densities shown in table 9. These numbers do not include task organized air defense, artillery, engineer, and other combat support elements traveling with the battalion.

March rates vary from five to fifteen kilometers per hour (kph) when moving cross-country, to twenty to thirty kilometers per hour when traveling on roads in daylight.⁴² Interval between vehicles in a company, and between companies of a battalion, is twenty-five to fifty meters.⁴³ Figure 23 depicts doctrinal spacing for a tank battalion moving toward the forward edge of the battle area (FEBA). March formation widths are dependent upon available mobility corridors, remembering that this formation balances force security, better offered by off-road movement, with speed, inherent in movement on improved roads and trails.

TABLE 9
VEHICLE DENSITIES IN BATTALION ORGANIZATIONS
OF A MOTORIZED RIFLE REGIMENT (BMP)

	Motorized Rifle	Tank
Armored Personnel Carriers..	39	2
Tanks.....		31
Trucks.....	24	12
Total Vehicles	63	45

Source: US Army, FM 100-2-3, The Soviet Army: Troops, Organization and Equipment (Washington, DC: Department of the Army, 1984), 4-27 thru 4-28.

Air defense supporting a march formation is task organized and is either oriented to choke points along the route of march or moves with the march formation, depending on the threat from enemy aircraft.⁴⁴ Company commanders typically direct engagements with their organic SA-7/14 systems, which are spread throughout the formation. SA-13 and ZSU-23-4 platoons are often task organized, allowing the regimental commander to position one element to protect the march formation while the other displaces.⁴⁵

These comments suggest the target's formation is influenced by effects of its own mission, the air threat (enemy), terrain, its task organization (troops), and the time available to an enemy commander to influence the action. Despite these factors, and the resulting target permutations, a reinforced tank battalion, in march formation, acting as an advanced guard, is shown in figure 24 as a representative attack helicopter target.

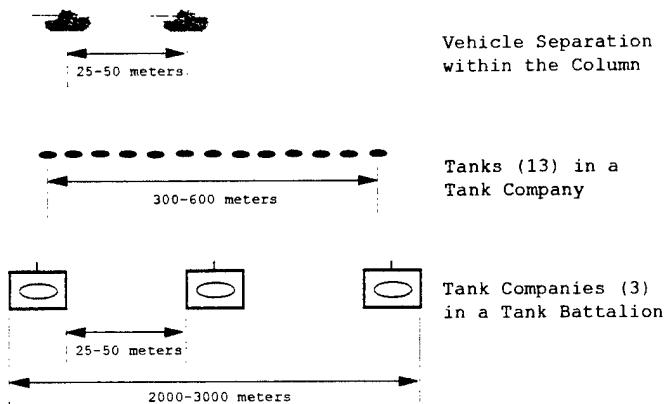


Fig. 23. Tactical March Depths and Spacing for a Battalion-Size Organization. Source: US Army, FM 100-2-1, The Soviet Army: Operations and Tactics (Washington, DC: Department of the Army, 1984), 5-3.

The Action: An Attack Helicopter Battalion Engagement Sequence

Chapter 3 introduced the reader to the concept of an attack helicopter engagement sequence; those actions taken by attack helicopter units to close with, and engage, a massed target. This sequence is portrayed graphically below in figure 25. Chapter 1 delimited the study's discussion of ATKHB actions to those around the "hypothetical

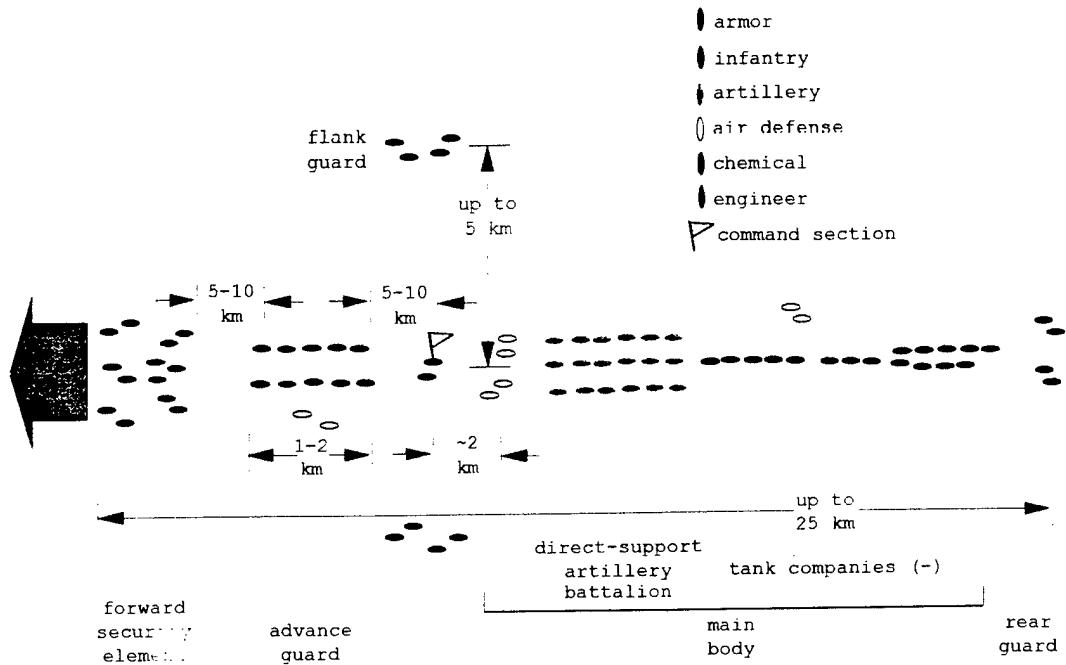


Fig. 24. March formation of a reinforced tank battalion (MRD) acting as an advanced guard or forward detachment. Source: US Army, GTA 30-1-24, Soviet Doctrinal Templates (Fort Monroe, Virginia: HQ TRADOC, 1984), Template 7.

engagement area," or those activities annotated steps 1 through 4 of the diagram below. These concepts are presented in more depth in FM 1-112, Tactics, Techniques, and Procedures for the Attack Helicopter Battalion,

and in ARTEP 1-187-30-MTP, Mission Training Plan for the Attack Helicopter Company.

Step 1. Holding Area (HA) Occupation

A holding area is a covered, concealed position that is occupied for short periods. Occupation of a holding area allows for final reconnaissance and coordination of assets by the ATKHC commander.⁴⁶

Each attack helicopter company of a battalion is typically assigned its own holding area. The location of these positions, with respect to the intended engagement area, typically means the unit is vulnerable to enemy indirect fires. As a result, the aircraft will not shut down their engines and will relocate if lengthy delays are encountered. Face-to-face coordination is accomplished to prevent enemy radio direction-finding.⁴⁷

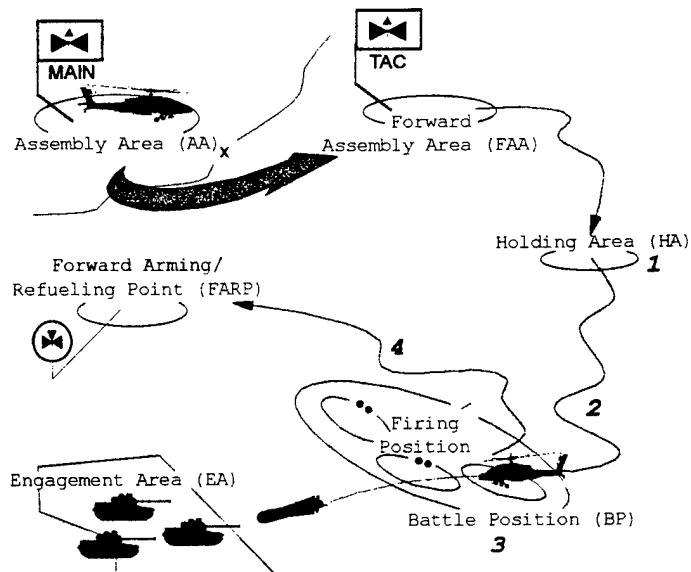


Fig. 25. Representative Attack Helicopter Engagement Sequence⁴⁸

Occupation of the holding area is preceded by an area reconnaissance. Once clear, a technique is for the ATKHC commander to place his aircraft at the twelve o'clock position (figure 26), the light platoon to occupy positions from twelve - six o'clock, and the heavy platoon to move into locations from six - twelve o'clock. All aircraft are oriented on likely ground and air avenues of approach into the position and are situated to ensure visual contact with adjacent aircraft.⁴⁹ Apart from final coordination before the attack, units may temporarily occupy holding areas to provide scout aircraft in the company an opportunity to recon attack routes into the battle position (BP).

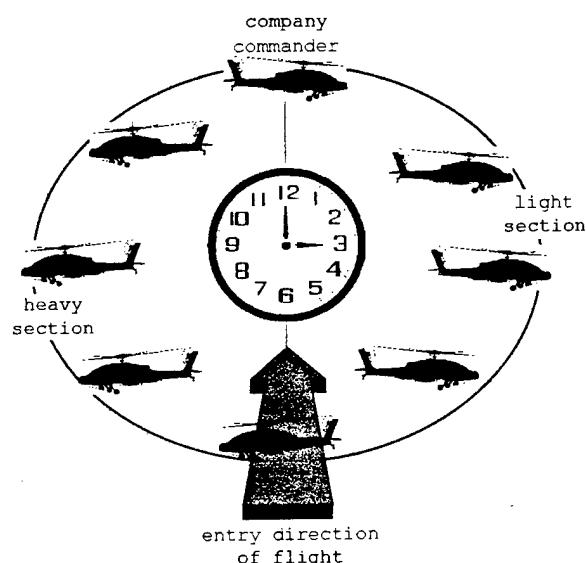


Fig. 26. Holding area occupation by an Attack Helicopter Company.
Source: US Army, FM 1-112, Tactics, Techniques, and Procedures for the Attack Helicopter Battalion (Washington, DC: Department of the Army, 1991), 4-5.

Step 2. Movement along Attack Routes

Attack helicopters move from the HA to the BP over attack routes. Properly selected attack routes allow attack helicopters to move undetected, ensuring initial surprise in the attack.⁵⁰

ATKHCs move over multiple attack routes into their assigned battle position. Using a movement technique called bounding overwatch, the company will "leap-frog" elements forward, establishing an overwatch position with one while the other moves. The movement method is used when the possibility of enemy contact is expected. Moving units will not bound beyond the maximum effective range of the overwatching element's 30mm chain gun (four thousand meters)⁵¹, and will use nap-of-the-earth (NOE) terrain flight techniques: flying as close to the surface of the earth as natural and man-made obstacles will allow. This process continues until the company arrives at its assigned battle position. Aircraft functioning as scouts for the company may move forward into the intended BP to conduct a final reconnaissance and select firing positions for the remaining aircraft.

Step 3a. Selection and Occupation of Battle and Firing Positions

"Battle positions are chosen based on factors that improve the survivability of attack aircraft and increase the likelihood of a successful attack."⁵² Within battle positions, firing positions are selected for occupation and engagement by individual aircraft. The base requirement of either a battle or firing position is that it places the intended target within maximum effective ranges of the AH-64's organic weapon systems.

Highlighting a few of the characteristics doctrine suggests are important for firing and battle positions will allow their comparison with submarine firing positions in chapter 6. Favorable firing and battle positions are located to the flanks and rear of the intended target, allow the aircraft to shoot with some background terrain or vegetation to reduce its visual signature, place the sun at the firing aircraft's rear, and are clear of loose snow or vegetation the rotor system might throw into the air and which could cue the target, or supporting air defense systems, of the aircraft's presence.⁵³

After identifying the intended target, scout aircraft of the ATKHC's subordinate elements will direct attacking aircraft into firing positions within the BP. Once the attacking helicopters are positioned, scouts can either move to the flanks and rear of the battle position to provide the attacking force's security, or be involved in the engagement by designating targets remotely for other aircraft of the team or section. Figure 27 illustrates what an ATKHC might look like in a battle position.

Step 3b. Attack Helicopter Fire and Maneuver

Attack helicopters may engage individually, by section, by section using remote and autonomous fires, by teams, or by company (simultaneous).⁵⁴ Considerations of the unit's mission, characteristics of the enemy force, available aircraft, geography around the engagement area and battle positions, and time will dictate which method the company should employ.

The spectrum of engagement methods varies from an individual aircraft, stressing speed but sacrificing centralized fire control, to the simultaneous engagement, requiring time for the entire unit to position itself in firing positions but offering the most control over the unit's fires.⁵⁵

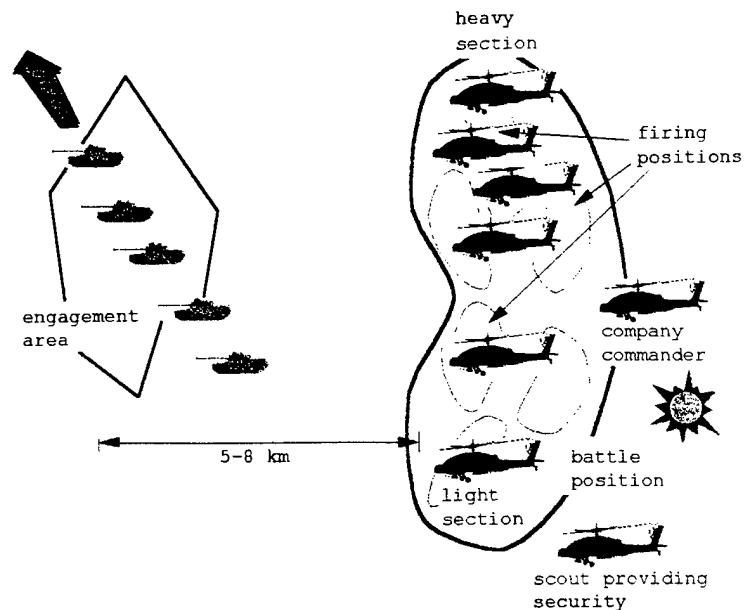


Fig. 27. Attack Helicopter Company occupying a Battle Position

Chapter 1 introduced the ATKHB's continuous employment technique and discussed company rotations into a fight in order to maintain pressure on a target. Companies also maneuver their subordinate sections and teams during the course of an engagement to maintain pressure on the target while enhancing survivability. Like the continuous employment technique, the basic premise is to maneuver one element while the other continues to engage the target. Methods of

maneuver are tied to the engagement: ATKHC maneuver is accomplished by individual aircraft, attack section, or by team.⁵⁶

Step 4. Breaking Contact and the Battle Handover

Breaking contact with the enemy is as important to the ATKHC as beginning the engagement. The break in contact should be swift, decisive, and leave the enemy in doubt as to whether it is still being engaged. The company may break contact by attack section or simultaneously.⁵⁷

Attack helicopter units use the battle handover when passing the engagement between companies of the ATKHB, or between ATKHBs of a larger organization. Scout aircraft and the company commander of the unit in contact may brief oncoming elements in their assigned holding areas or by radio if time is short. Figure 28 shows a battle handover line (BHL) as one graphical control measure used to indicate passing the engagement from one unit to another.

Counteraction

The target and supporting air defense will employ a number of techniques to reduce both their own vulnerability to air attack and, if attacked, to minimize the attack helicopter's effectiveness. Both passive and active air defense measures are used.

The Target's Counteraction

The target's passive measures include vehicle dispersion in the march and using the terrain for concealment (Americans call this terrain driving). Both sacrifice rate of movement, the primary consideration in former-Soviet doctrine for the march formation. Trading dispersion and concealment for speed was, perhaps, acceptable risk when facing the AH-1

Cobra. The longer ranges and higher speeds of the AH-64, however, increase the helicopter's deep attack capability and the danger to enemy second echelon and reserve units in the march.

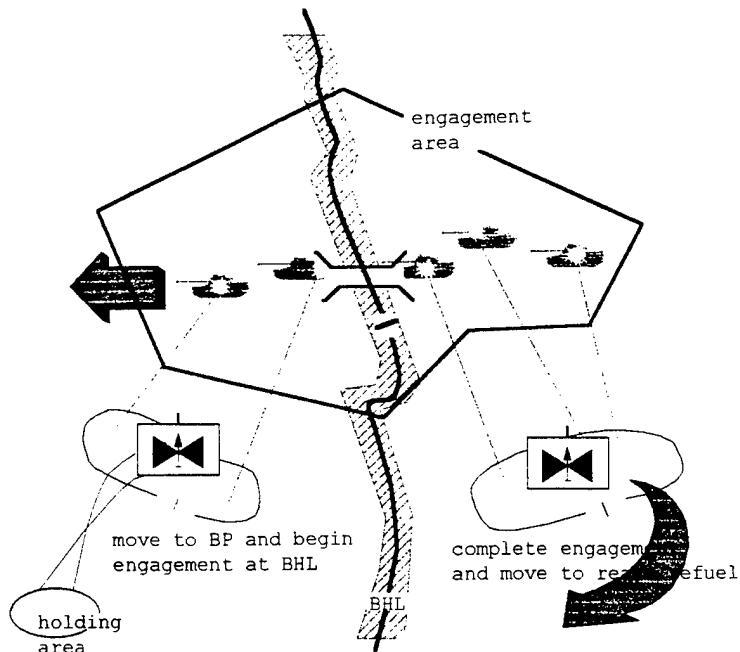


Fig. 28. Battle Handover. Source: US Army, FM 1-112, Tactics, Techniques, and Procedures for the Attack Helicopter Battalion (Washington, DC: Department of the Army, 1991), 4-33.

Commanders will post air guards on each vehicle and disperse their organic SA-7/14 missiles throughout the march column. Response to an air attack includes increasing the march interval and speed. Doctrine suggests dispersing off the route of march to find greater concealment is a last resort.⁵⁸

Counteraction by the Counterforce (Air Defense)

Air defense for the march normally is planned in advance and includes organic and supporting antiaircraft weapons and aviation. Air defense weapons can be located in the column or in stationary positions occupied in advance. Normally, the weapons are distributed throughout the column.⁵⁹

Former-Soviet air defense doctrine highlights choke points and continuous air defense coverage. Choke points will slow the march formation and cause units to mass, presenting a lucrative target to attack helicopters. Doctrine suggests that these locations are candidates for air defense ambushes, typically consisting of one or more ZSU-23-4 and SA-7/14 systems.⁶⁰ While these elements are supporting the unit's movement, they are more independent than assets moving with the formation.

Air defense radar are not used unless the risk of attack outweighs the risk of detection. SA-6 and SA-8 SAMs are sometimes dedicated to protecting march formations and augment the regiment's organic air defense with significantly greater weapon, detection, and acquisition ranges.⁶¹

Conclusion

The air campaign during Desert Storm targeted and destroyed a large portion of Iraq's air defense prior to the ground war, resulting in the inability to validate doctrinal counteraction precepts outlined above. AH-64 units faced only sporadic air defense, which ultimately destroyed only one Apache. Despite the difficulty in validating Soviet-style air defense concepts, some might attribute successes of Allied SEAD efforts preceding the ground attack to accurate templating,

indicative of a thorough understanding of how these forces are organized and fight.

In contrast, Desert Storm did provide a benchmark against which attack helicopter tactics (the action) and forces proved successful. AH-64 units effectively engaged massed armored and mechanized targets at long ranges, and in limited visibility, predominantly using Hellfire and 30mm weapons. Extended distances in the desert required ad hoc command and control arrangements and the terrain modified doctrinal considerations for holding area, battle position, and firing position selection.

These considerations of the attack helicopter battalion's environment, and the mechanics of those engagements, now completes the second of two pillars necessary to accomplish a comparison with the wolf pack experience.

CHAPTER 6

THE COMPARISON

The Central Research Question

Is there a parallel in the tactical employment of World War II wolf packs and modern attack helicopters?

Chapter 1's story of the wolf pack engagement against Mo-Ta 30, and "Ali" Cremer's (U-333 Commander) use of the word "hovering"¹ in describing the nature of submarines, offer glimpses of the comparison between wolf packs and attack helicopters, but only at the superficial level. These examples convinced the author of an affirmative answer to the research question, yet lacked depth necessary to argue the comparison successfully, and resulted in the work on this thesis.

The depth was offered in chapters 4 and 5, which used four battlefield mechanics to discuss the World War II wolf pack and modern attack helicopter experiences. Despite this arduous process, the author's original impressions are unchanged: there is a parallel in the way these two forces fight.

Determining an answer required looking at both: (1) *What* these forces are doctrinally tasked to do, as well as (2) *How* they do it. The first involved analysis of the force mechanic, as its original definition included a description of the doctrinal tasks wolf packs and attack helicopter battalions were organized to accomplish. "How" explored the action these forces take against their respective massed

targets. Both were accomplished in subsequent sections and included appropriate target and counterforce considerations, as they were important to analysis of the "what" and "how."

What are these Forces Tasked To Do?

World War II Wolf Pack Tasks

Chapter 4's discussion of the World War II wolf pack experience highlighted a 1935 statement by one of Doenitz's U-boat commanders regarding the pack's tasks: "The object would be to locate the enemy, to report his position and to attack him with the greatest possible number of U-boats."² FM 100-5, Operations, the U.S. Army's keystone doctrinal manual, would define these "objectives" as reconnaissance and attack operations.

German wolf packs accomplished the reconnaissance task with formations of U-boats specifically organized for that purpose, the "reconnaissance or look-out formations," which Doenitz highlighted employed a follow-on to torpedo boat tactics. The U-Boat Commander's Handbook detailed the first two submarines locating the target as the "contact holders," responsible to maintain contact with the convoy, provide hourly position reports, and to transmit "homing" signals to other submarines moving to the target.

In the Pacific, "Babe" Brown and "Swede" Momsen's recommendation to adopt wolf pack tactics suggested:

that several boats operating against a convoy not only brought more firepower to bear but also tended to be mutually supporting defensively: one boat could draw away escorts holding down and pounding another.³

Again, the attack task is specified. Reconnaissance, while not mentioned in the quotation, was obviously recognized as an implicit requirement, as packs routinely formed "scouting lines" to find the convoy in advance of an attack. Smaller U.S. Navy wolf packs, typically three submarines, as opposed to the larger formations in the Atlantic, began their action with the scouting line, also employed a "contact holder" to report the convoy's position while maneuvering for its own attack, then used the entire pack as an attacking force. One boat was normally tasked to trail the convoy, reporting details of the target's movement, as well as to destroy "stragglers" from the mercantile formation.

The Attack Helicopter Battalion's Tasks

Chapter 5 outlined the ATKHB's doctrinal mission of "destroying massed enemy mechanized forces."⁴ Arguably, the ATKHB is capable of performing a variety of tasks, but its specified mission in FM 1-112, Tactics, Techniques, and Procedures for the Attack Helicopter Battalion, leaves no doubt regarding its primary objective. Just as with wolf packs, reconnaissance, specifically, gaining contact with the enemy force, is outlined in FM 1-112 as a critical step in the engagement sequence. Doctrine highlights actions by the attack helicopter company's (ATKHC) aeroscouts in the vicinity of the battle position, and dictates procedures based on the enemy situation:

If the enemy has not yet arrived in the engagement area, the aeroscouts will continue to observe the engagement area and the battle position. The aeroscouts send a spot report of the enemy situation and the suitability of attack section battle positions.

If a battle handover is being accepted from another company or reconnaissance troop, the aeroscouts move to a holding area to meet with the ATKHC or reconnaissance troop commander whom they are relieving. Once the situation has been briefed, the ATKHC aeroscouts relieve the on-station aeroscouts and begin continuous observation.⁵

General Task Conclusions

Each force is required to gain and maintain enemy contact so that their primary task of destroying the massed target is possible. Specified subordinate elements to the wolf pack and attack helicopter battalion are assigned the reconnaissance task. That reconnaissance leads to directive action from the scouting element, allowing the balance of the force to close with, and attack, the target. Maintaining contact, continuous reconnaissance, is a critical requirement to either force, allowing battle handover to successive elements.

There is, however, a difference in the scale of these tasks, which is an inescapable byproduct of the land and ocean environments in which these forces fight. The differences, while important to highlight, do not detract from the fundamental similarity in tasks both the wolf pack and attack helicopter perform.

Comparing the Reconnaissance

Deployed wolf packs were often required to employ strategic-level intelligence (i.e., radio intercept information regarding the probable location of mercantile convoys) in developing their tactical engagements. Although arguably a "dated" contrast, in that modern wolf packs, if used, could benefit from strategic reconnaissance (i.e., satellite imagery) to refine their search areas, it is a broader requirement than the same task for an attack helicopter force. This

distinction does not address the requirement for continued reconnaissance, a task made more difficult for the World War II submarine with its limited sensor suites and marginal speed advantage over the target. These issues are explored more fully later in the chapter.

Comparing the Attack

It is interesting to note that neither force is defensively-oriented. Even when employed within the framework of a defense, each must attack to accomplish the missions outlined in chapters 4 and 5. The force-orientation for attack helicopters, however, has associated spatial and time limitations which that of the wolf pack typically does not.

With the exception of the Pacific theater, where narrow straits and minefields sometimes presented finite windows of time for the wolf pack's engagement, pack actions were largely unbounded in both time and space. Torpedoes, rations, fuel, and human endurance offered the only significant restrictions to an engagement's endurance. Even where shore-based anti-submarine air reconnaissance, or other restrictions to the engagement, might exist, the action was still less bounded than commensurate engagements by attack helicopter forces. These spatial and time limits on land action seem largely the result of actor density, with the number of friendly land forces within a geographic area typically greater than for actions at sea.

In land combat, graphical control measures "neatly" divide the battlefield among responsible commanders, and are used to synchronize

the activity of forces operating in close proximity to one another. Chapter 5's discussion of the attack helicopter engagement sequence shows engagement areas, battle positions, and holding areas, all defined by control measures drawn on a map. These are intended to communicate what the attack helicopter force intends to do in the vicinity of the engagement area to those forces nearby, whose own action might adversely affect the ATKHB's action, or to those elements supporting the engagement, i.e., field artillery. The ATKHB is oriented to an enemy force, but constrained by lateral boundaries defining unit responsibility. Implicitly, the combination of a geographically-constrained, force-oriented attack, places time restrictions on the attacking force. These limitations are alleviated through use of the terrain, complemented by man-made obstacles, as well as maneuver and fires, to constrain the enemy's ability to move.

Comparable description of the wolf pack engagement sequence begins with similar control measures, i.e. waiting and action stations, with the "battlefield" divided into marinequadranten. However, once the engagement commenced, history records no examples where a wolf pack broke contact or handed off the battle to another force because the enemy had crossed a graphical boundary, a distinct possibility in land combat. The homogeneous nature of oceanic "terrain," away from littoral regions, offers few means of constraining enemy movement, and characteristically fewer naval forces operating within a geographic region combine to require a relatively unconstrained force-oriented attack by wolf packs. Battle handover is explored in more depth later in this chapter.

How Do these Forces Perform their Assigned Tasks?

Chapter 3 promised an analysis of engagement sequences for the wolf pack and attack helicopter battalion. Presented individually in chapters 4 and 5, their comparison here intends to focus on the action's purpose with the attack helicopter's action beginning with the force's occupation of a holding area, and the wolf pack with their positioning inside waiting/action stations, or along scouting lines (figures 29 and 30). Subsections step through the engagement, with each element's title formatted (helicopter/submarine) to relate individual force sequences described in previous chapters.

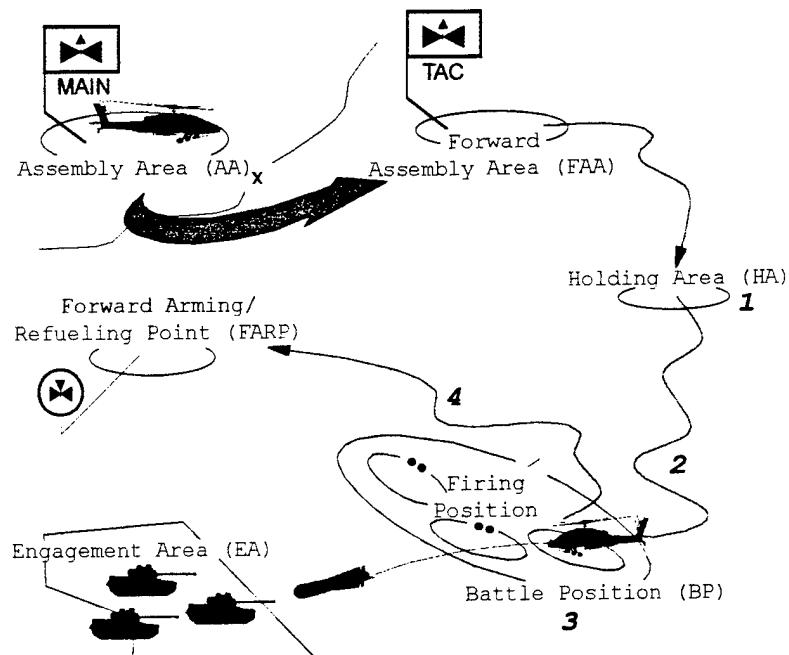


Fig. 29. Attack Helicopter Engagement Sequence

Holding Area/Waiting or Action Station Occupation

An attack helicopter holding area "allows for final reconnaissance and coordination of assets,"⁶ while the wolf pack waiting station places submarines in areas of likely convoy activity, yet allows U-Boat Command the opportunity to refine "details of a given target" or to develop information about other "important targets."⁷ In either case, the purpose of these positions is to refine information about an impending attack.

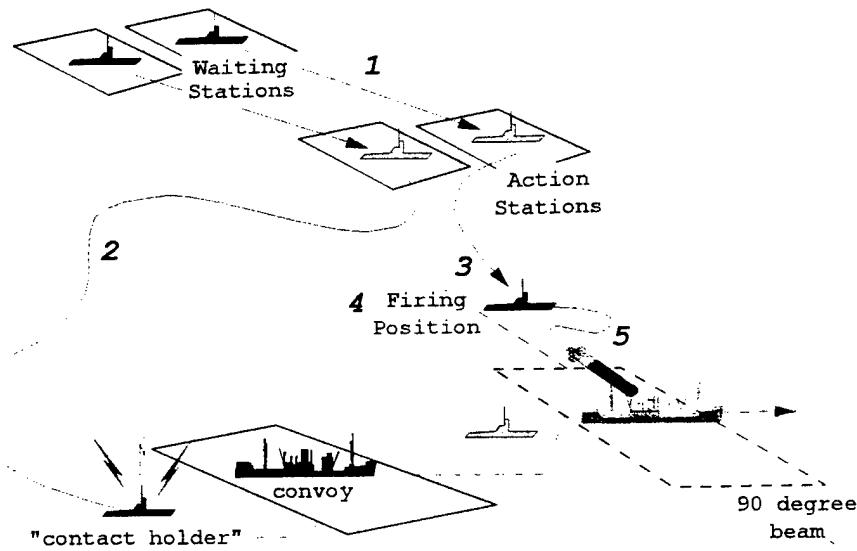


Fig. 30. Wolf Pack Engagement Sequence

Differences include the length of time either force may occupy these locations: the holding area only for short periods, while a stay in a waiting station, although not specified in the U-Boat Handbook, implies a longer occupation. Attack helicopter forward assembly areas offer greater similarity to the waiting station (the ATKHB "occupies

forward assembly areas for extended periods while awaiting orders to execute missions"⁸), with wolf pack action stations (submarines are directed to action stations in order "to contact a particular enemy unit"⁹) more analogous to the holding area. The history of Pacific wolf packs does not identify locations like the action or waiting station, although scouting lines, similar to Doenitz's "lookout formations," are highlighted as the position from which attack operations commenced.

The distinction in these locations, however, is unimportant. Each force doctrinally designates positions in the vicinity of the expected target where final target reconnaissance is completed before commencing an attack. The relationship of these starting points to the target area is a function of the battlefield's scale and requirements of each force's reconnaissance.

Movement along Attack Routes/Departing Action Stations and Movement to Firing Positions

For the attack helicopter force, attack routes are used by multiple aircraft, with an ATKHC normally employing more than one route. Terrain flight techniques are selected which balance the necessity for speed and stealth, described in Chapter 4 as an important characteristic of the "overhauling maneuver" by individual U-boats along their analogous "attack routes." This phase of the force's action, however, highlights an important distinction in the capabilities of helicopters and submarines in comparison to their intended targets; speed advantage.

Force Speed and the Capability to Maneuver

The U-Boat Handbook stresses perseverance in the approach:

The overhauling maneuver and the attack should not be abandoned even when the bearing shows little movement of the enemy. Do not let the difficulties wear you down!¹⁰

Clay Blair, Gene Fluckey, and Dick O'Kane each offer examples of the endurance race involved with a submarine, hence wolf pack, closing on the target. The attack helicopter, in contrast, spends an order of magnitude less time in the approach than her submarine counterpart, with the underlying reason, the speed advantage of the force over target.

The wolf pack moves in the same fluid medium as her prey, while the helicopter does not. Chapter 4 highlighted that while on the surface, submarines were only a few knots faster than "slow" convoys, and were often unable to "overhaul" faster formations. Any advantage enjoyed on the surface is lost when forced to submerge.

Helicopters, on the other hand, although operating in the ground environment, are unconstrained by it. While flying at nap-of-the-earth altitudes and slower airspeeds in the vicinity of the target, helicopters will also employ higher speed low-level and contour terrain flight techniques further from the threat. LTC Bryan's description of the Battle of the Causeway, referred to in chapter 5, highlighted the attack helicopter force's capability to conduct high-speed, low-altitude ingress. Table 10 compares both forces to their corresponding target rates of movement. Again, depicted AH-64A velocities are maximum speeds, and would not reflect airspeeds used in the target's vicinity. However, the table does highlight the order of magnitude associated with these forces' speed advantage, a characteristic inextricably tied to maneuver.

TABLE 10
FORCE TO TARGET SPEED COMPARISONS

	AH-64A	Soviet March Rates	Type VIIC	Gato-Class	Atlantic	Atlantic
			U-Boat	Submarine	Fast Convoy	Slow Convoy
Max Velocity						
@ Max Weight....	287					
Max Velocity						
@ Low Weight....	363					
Day (on road)...		30				
Night (on road)...		20	Surfaced.....	33	39	18.5
Cross Country...		15	Submerged.....	14	17	14

(All Speeds in Kilometers/Hour)

FM 100-5 defines maneuver as: "the movement of combat forces to gain positional advantage, usually in order to deliver--or threaten delivery of--direct and indirect fires."¹¹ The German use of this term in labeling the "overhauling maneuver" is appropriate in light of the FM 100-5 definition, with the difficulty in accomplishing this action an amplification of the point relating speed to a force's ability to maneuver. The U-Boat Handbook uses expressions like "fighting its way forward," "nibbling at the horizon," and "strenuous efforts to overhaul the enemy,"¹² in describing the submarine's inherent speed disadvantage and the difficulty this presents. This does not suggest, however, that wolf packs were incapable of maneuver; the end-around maneuver employed successfully by Pacific theater wolf packs an important example to this issue. Maneuver is explored again later in the engagement sequence.

It is important to appreciate the difficulty submarine forces have in maneuvering, but equally critical to recognize that their actions from the scouting line or waiting/action stations is, by FM 100-5, maneuver. In either case, the purpose of an attack helicopter or wolf pack's movement from holding areas, or these previously-mentioned

pack-specific locations, is the occupation of a suitable firing position.

Occupation of Battle and Firing Positions/Approach and Engagement

Chapters 4 and 5 described important characteristics of optimal firing positions for their respective forces. Using the doctrinal guidance of FM 1-112, key aspects of those positions are compared in table 11. Many of the considerations outlined for attack helicopter firing positions necessarily consider effects of terrain on the helicopter, and the target's ability to employ terrain for cover or concealment. These are, obviously, not applicable to oceanic "terrain" on which the wolf pack fights. This differences aside, remaining considerations are remarkably similar, with the exception of target standoff.

TABLE 11
COMPARISON OF ATTACK HELICOPTER AND SUBMARINE
FIRING POSITION CHARACTERISTICS

	Attack Helicopter	Wolf Pack
Orientation to Target..	flanks and rear	flanks: 90-60 degrees from track
Obstacle Clearance.....	required	N/A
Range to Target.....	standoff desired	300 - 1,000 yards
Background.....	recommended	recommended
Altitude.....	desired	N/A
Sun.....	to the force's back	to the force's back
Shadows.....	desired	N/A
Cover and Concealment..	desired	N/A
Rotor Wash.....	minimized	slow speeds; from windward
Fields of Fire.....	desired	N/A

Target Standoff

Unlike submarines, helicopters are unable to use the medium in which they operate for concealment. Flying, while decoupling helicopters from the burdens of terrain obstacles, increases their signature. In contrast, "the chief characteristic and strength of the submarine is its invisibility due to its ability to submerge."¹³

Doenitz specified six hundred yards in Memoirs as the "short range" so that "any minor error in torpedo firing could hardly have any effect."¹⁴ The U-Boat Handbook further outlined a range of three hundred meters to allow the torpedo minimum safe arming distance.¹⁵ Neither of these considerations mentions a need to fire from outside the enemy's engagement ranges, and numerous historical accounts from both theaters describe individual submarine penetration of the escort screen to the vicinity of the convoy, sometimes inside the formation itself. Interestingly, even FM 1-112 recognizes that "shorter ranges make acquiring and gaining a first round, or burst easier."¹⁶ The emphasis here is an obvious desire to increase torpedo effects, with apparent reliance on the "invisibility" a submarine's capability to submerge can provide.

However, Norman Friedman points out in U.S. Submarines through 1945 that experience in the Pacific war unexpectedly showed that fire-control errors were more likely at shorter ranges, a result of the greater bearing (angle from the submarine to the target) change rate.¹⁷ These errors unexpectedly decreased the effectiveness of American torpedo attacks at ranges less than 1,500 yards, indicated the optimal range at about 1,500 yards, resulted in eighty to eighty-five percent

effectiveness at ranges between 1,500 and 3,000 yards, and showed that accuracy beyond 3,000 yards "dropped off quite sharply."¹⁸ American analysis also indicated that:

The closer the submarine, the better the chance that a counterattack would succeed; 31 percent of counterattack shots fired within a distance of 1,500 yards found their marks. That figure fell to 24 percent for attacks executed at 1,500-2,500 yd¹⁹ and to only 17 percent for attacks beyond 2,500 yd.¹⁹

Active counteraction of modern air defense forces requires target standoff, with attack helicopter doctrine highlighting that shorter ranges, "2,000 meters or less from the engagement area,"²⁰ are a distinct disadvantage. Although improved from the nearly twenty-two seconds required to fire and track wire-guided missiles from the AH-1 Cobra, at a minimum, remote laser designation requires at least one aircraft expose itself to the target to accomplish the remote engagement. At worst, autonomous firing requires the helicopter remain exposed from designation through missile impact. Either increases risk to the designating aircraft, a danger mitigated with increased range to the target.

Although fire control and torpedo improvements have undoubtedly increased the probability of hit at increased ranges, a fundamental distinction in these two forces is the wolf pack's ability to engage the target while submerged. The U-Boat Handbook explains:

The characteristic of invisibility serves both as a means of attack and a means of protection, and thus forms the basis for the naval use and suitability of the submarine.²¹

Standoff remains a distinction between the action of these two forces, although, ironically, Pacific wolf pack experiences indicated

some standoff benefit and modern attack helicopter doctrine highlights increased probability of kill at closer ranges.

Fire and Maneuver

Launching an anti-tank missile or torpedo from a suitable firing position is clearly similar for both forces, even with recognition of the technological advances forty years has allowed the modern attack helicopter force to enjoy. However, one of the most interesting comparisons between these forces is the use of fire and maneuver by both American helicopter units and Pacific wolf packs. This maneuver is in contrast to the "dogged" character of a German wolf pack engagement:

The most important task within which the submarine is faced on sighting enemy convoys is to attack them, and to endeavor to repeat the attack again and again. The submarine must not allow itself to be shaken off. If it is temporarily repulsed or forced to submerge, it must continue to press on, again and again, in the direction of the general course of the convoy, seek to contact it, and renew the attack.²²

The clear difficulty in breaking contact with a mercantile convoy is in finding it again. Chapter 4's description of the end-around maneuver, analogous to the actions of an attack helicopter force in moving from battle position to battle position, highlights the capability radar provided American submarines with this technique. "Attempted at night without radar the tactic was comparable to a fast game of blind-man's bluff. It demanded astute guesswork as well as expert mathematical calculating."²³ American submarines, unlike their German counterparts, were equipped with radar, as early as the Summer of 1942, which "could locate surface vessels and indicate directional

bearings as well as range."²⁴ This capability offered a distinct advantage to the American wolf packs, and provides some justification for the differing emphasis to maneuver by packs in the Pacific.

It is important to note the contrast here is between the two World War II wolf pack experiences, and not between the attack helicopter and submarine forces. FM 1-112 highlights the requirement for fire and maneuver by engaging attack helicopter forces, mandated by the increased threat in the vicinity of an engagement area and the aircraft's current requirement for some portion of the force to expose itself during an engagement. Surface engagements by submarines, conducted by both theater's packs in an effort to enhance target visibility, would benefit from fire and maneuver, especially given the submarine's ability to submerge and move away from the engagement. Radar, as discussed by Roscoe in United States Submarine Operations in World War II, enhanced the U.S. Navy's capability to fire and move over their Atlantic counterparts.

Breaking Contact and the Battle Handover/Maintaining Contact

FM 100-5 highlights that attacks are conducted "to defeat, destroy, or neutralize" an enemy force, with FM 1-112 suggesting that selection of an attack helicopter employment technique is necessarily related to the desired target effect. Where destruction is desired, attack helicopter battalions may use the continuous employment technique to maintain pressure on a target, rotating forces into the engagement until the required devastation is achieved. Defeat or neutralization effects may suggest alternative techniques.

In contrast, history suggests only one desired outcome of a wolf pack attack: destruction of the mercantile convoy. The pack's ability to maintain contact ultimately determined whether the task was achieved or not. This requirement, and the capability of American over German wolf packs (i.e., radar), offers additional insight to the distinct flavor of their engagements. With destruction as an objective, and without easy means (i.e., radar) of regaining contact with the target, German doctrine appropriately highlighted the necessity of maintaining physical contact with the convoy.

This requirement was no less important for American packs, but radar, arguably in conjunction with more coastal sea lanes in the Pacific theater (as opposed to intercontinental sea lanes of the Atlantic theater), offered greater opportunity for the pack to maneuver during their engagement. In Silent Victory, Clay Blair offers a number of instances where wolf packs moving into an area received a battle handover from other packs and single submarines in contact with a target. This does not suggest the Germans did not handoff engagements from pack to pack, but merely explains their increased difficulty in doing so.

Maintaining contact is also related to these two forces' "scope" of reconnaissance and speed differential over their targets. Attack helicopter forces refuel and rearm in closer proximity to the target than their submarine counterparts, resulting in the enemy's inability to move long distances before the force can use its mobility advantage to regain contact for successive engagements.

The advantage of rearming and/or refueling in close proximity to a fight was exhibited by Donc's Devils in the Luzon Strait in late-August, early-September 1944. Individual submarines cycled through Saipan before returning to the Straits with Blair recounting that:

Donc's Devils turned out to be one of the most successful double-barrel packs of the war. In two forays, Donaho, McGregor, and Underwood sank thirteen confirmed ships for almost 65,000 tons. . . . The advance base at Saipan, which enabled all three boats to refuel and reload, had already paid for itself.²⁵

The Finale

There are unmistakable differences in the way these two forces are organized and fight, many highlighted in this chapter, and a number of others left undiscussed. Those so inclined will undoubtedly discover every reason to disprove the central thesis' conclusion, and are welcome to do so. However, the chapter's discussion, focusing on the *force* and *action* mechanics, indicates more similarity between what these forces do, and how they do it, than difference.

Could an attack helicopter battalion, without considering the ranges over which it must operate, close with and destroy a mercantile convoy or could a wolf pack operate against a massed enemy mechanized or armored target? The answer to these questions is clearly in the negative. Each force employs the characteristics of its unique land and sea environment to maximum advantage, impossible to separate from consideration of the *action*. However, the reconnaissance and attack tasks each force accomplishes (*what they do*), while exhibiting differences in scope, are similar. The steps each force negotiates to place itself in favorable position with respect to the target (*how they*

do it), suffer similar differences in scope, but like the task, ultimately demonstrate more that is alike than different.

The result is cause for celebration, in that individual histories of the wolf pack and attack helicopter forces, through these similarities, are able to offer lessons learned to one another. Future studies might now evaluate how and why submarine forces evolved away from the wolf pack tactic, and toward the high-stealth, autonomous systems employed around the world today. Perhaps refined study of this evolution, given this thesis' data point, will describe a similar path attack helicopter forces might take in their development into the next century. The risk is in "reinventing the wheel." The payoff remains unexplored.

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